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Director –

CURRENT RESEARCH PROGRAMMES : IIP

The research and development programmes of the Indian Institute of Petroleum (IIP), Dehra Dun comprise the following broad areas: evaluation of crude oils and products and quality control process development; appliance development; development of testing facilities; product application; basic researches; process design and pre-investment techno-economic studies. Out of 86 projects under investigation, 69 are applied research projects and 17 are of a fundamental nature. Forty-nine projects have been undertaken at the request of other organizations such as the Indian Oil Corporation Ltd, Indian Petrochemicals Corporation Ltd, Oil & Natural Gas Commission, Ministry of Petroleum and Chemicals, Ministry of Defence, and Indian Standards Institution, and industries. The remaining 37 projects, taken up at its own initiative, are aimed at developing know-how for adaptation of known or new processes to meet the requirements of oil and petrochemical industries.

A brief account of the scope and objectives of some of the important projects under the main areas is given in the following paragraphs.

Evaluation of Crudes and Products and Quality Control

Evaluation of crudes: This is a continuing activity of the institute for collecting basic data on the characteristics of crudes to assess both qualitatively and quantitatively the product pattern, i.e. of fuels, lubricants, petrochemical feedstocks and speciality products. Problems in this area originating from the Oil & Natural Gas Commission, Indian Oil Corporation Ltd, Indian Petrochemicals Corporation Ltd and Ministry of Petroleum and Chemicals are of prime interest to the public sector refineries and other entrepreneurs processing or using petroleum products. The expertise available at IIP has obviated the necessity of sending crudes abroad for evaluation and consequent payment of high fees in foreign exchange. In addition to the evaluation of indigenous crudes, evaluation of crudes obtained from Middle East, viz. Morgan, Darius, Rostam and Aghajari, is also carried out.

Evaluation of clays: Clays find use in the finishing of lube stocks, treatment of light aromatic extracts, removal of trace impurities from catalytic reformed feedstocks and re-refining of used lubricating oils. The imports of clays used for such purposes amounted to about Rs 40 lakhs/annum. As an import substitution project of vital interest to the petroleum refining industry, IIP has evaluated indigenous clays, and some have been found suitable as substitutes for the imported clays. Work on clays required for the treatment of kerosenes is in progress.

Evaluation of engine lubrication requirements: The project has been taken up at the instance of the Indian Oil Corporation Ltd with a view (i) to collecting data for recommending the performance level of a lubricating oil for a particular service; (ii) to developing laboratory engine test technique for lubricant evaluation; (iii) to developing user consciousness for performance assessment of the lubricant; and (iv) to developing a proper system of lubrication follow-up. Data of 23 field tests on diesel and petrol vehicles have been collected for further analysis and evaluation.

Volatility requirements of motor gasolines: The object of this project, referred to the institute by the Indian Standards Institution, is to evaluate currently marketed gasolines for vapour lock problems in Indian passenger cars and to work out a suitable test method for defining volatility and predicting vapour lock.

Combustion in diesel engines: Studies are in progress to evaluate the effect of fuels of different cetane numbers on engine performance and to determine the cetane requirement of various engines. The studies have been taken up at the instance of the Indian Standards Institution. The findings of the study would help determine the optimum requirements of additives (cetane number improvers) which are presently imported.

Process & Product Development

Rubber extender and processing oil: As rubber processing oils are imported, a project has been taken up at the request of the synthetic rubber manufacturing and reclaiming industry to find the feasibility of producing these oils indigenously. Feedstocks available from Indian refineries have been evaluated and the product developed has given satisfactory performance. Further studies are in progress.

Speciality products like white oils, petroleum sulphonates, transformer oils, microcrystalline waxes and ichthammol find wide application in cosmetic, pharmaceutical, electrical, and other industries. These are presently being imported. Studies are in progress to develop know-how for their production and evaluate indigenous feedstocks for the manufacture of these products, and commercialization of the processes developed.

Additives: Development of know-how for the production of additives presently imported is the objective of the project. Know-how has been developed on a laboratory scale for preparing an additive ('Cetol') which would raise the cetane number of marketed diesel fuels as required by current specifications. Large scale bench trials for commercialization of the process are under way.

Large quantities of additives are required for treating lubricating oils. Alkyl phenols form the basic ingredient of these additives. Successful laboratory studies have been carried out for the production of: (1) 2,6-di-*tert*-butyl-*p*-cresol used as an antioxidant additive and also in food and drug industries; (2) *p-tert*-butylphenol used in rubber, polymer and paint industries and as an additive in lube oils; (3) octylphenol used as intermediate for lube oil detergent additive and non-ionic detergent; (4) 2,6-di-*tert*-butylphenol used as a lube oil additive; and (5) 4,4-′ methylene-bis-(2,6-di-*tert*-butyl) phenol, an important lube oil additive. Bulk preparation of the products is under way.

Hydroprocessing and catalytic reforming processes: Studies in this field relate to the development of hydrogen processing of different crude fractions for refineries and petrochemical industries. The objective of these hydrodesulphurization and hydrogenation processes is to improve the quality characteristics such as colour, odour and stability of the products by the removal of sulphur and other contaminants. Inferior kerosene is hydrogenated to improve its smoke point and provide correlation between the smoke point and the extent of hydrogenation. In collaboration with the French Institute of Petroleum, processes for hydrodesulphurization (HDS) of different petroleum products have been developed. These have been licensed to Madras and Haldia Refineries.

Polymers: At the request of the Ministry of Petroleum and Chemicals, investigations are in progress to develop a process for the manufacture of polystyrene of high impact resistance. Initial work was started with natural rubber and later extended to synthetic rubber (SBR). A two-step process—mass prepolymerization followed by suspension polymerization—was studied. Products from glass reactor showed impact strength comparable to that of commercial products. Further work using bench scale stainless steel reactor (capacity, 10 litres) is in progress.

At the request of industry, work has been taken up to develop acrylic-based coating compositions which can withstand temperatures up to 80-90°C and are used mainly in the automotive industry and in domestic appliances. Optimum compositions based on acrylic acid and maleic anhydride were worked out and the coatings prepared showed good corrosion resistance and withstood temperatures up to 110°C for 21 hr.

Proteins from petroleum: The project has been taken up in collaboration with the French Institute of Petroleum. The process consists of microbiological conversion of the wax content of specific petroleum fractions into yeast cells rich in edible protein and essential amino acids. After successful laboratory trials, a pilot plant (one cubic metre fermentor gifted by FIP) for producing 15-20 kg per batch of protein concentrate using gas oil as the feedstock was set up. The plant was shifted to Koyali Refinery, Baroda during 1968-69. Samples prepared have been sent to the National Institute of Nutrition, Hyderabad, Central Food Technological Research Institute, Mysore, and France for edibility and acceptability tests. Work on the standardization of the parameters under large scale conditions is in progress.

Utilization of waxy residues

Synthetic fatty acids: Liquid phase oxidation of wax and waxy products by air has been taken up to produce synthetic fatty acids which would replace the edible oils consumed by the soap industry. Slack wax distillates from Barauni Refinery as well as some pure paraffins were oxidized under varying pressures using potassium permanganate as catalyst. Feed wax in the range C_{20}-C_{26} yielded a product containing 75% C_{10}-C_{20} acids, which possesses a potential market. For utilizing C_{20} acids for grease manufacture calcium salts are being prepared. Scale-up work is in progress in collaboration with a private industry.

Thermal cracking of wax: To utilize wax, work is in progress to assess the feasibility of producing higher olefins by thermal steam cracking of wax. Higher olefins are utilized as raw material for producing synthetic detergents and in other petrochemical industries. Experiments on commercial as well as slack waxes (oil content, 10-15%; bp, 400-530°C) under varying conditions of temperature, pressure, space velocity and hydrocarbon-to-steam molar ratio indicated a total conversion of 20-60% (by wt), the liquid yield (C_5-C_{17} range) being 40-60% (by wt) of the conversion.

Catalysts and catalyst supports: Processes for the production and evaluation of specific catalysts and catalyst supports needed in refining and petrochemical industries are being developed under this project. At present considerable foreign exchange is involved in importing these items. The institute has developed FIA grade silica gel suitable for hydrocarbon type analysis of gasoline and kerosene; alumina supports suitable for processing heavy feedstocks; town gas catalyst, hydroisomerization catalyst and deoxo catalysts. Facilities have also been developed for assessing physicochemical properties of materials, such as surface acidity, true and particle densities, adsorption and surface area measurements and pore size distribution, including differential thermal analysis and thermogravimetric analysis.

Solvent extraction and solvent dewaxing: At the instance of the Indian Oil Corporation Ltd (IOC), the feasibility of using methyl isobutyl ketone (indigenous) in place of methyl ethyl ketone (imported) for dewaxing lube stocks is being investigated.

Work has also been undertaken at the request of IOC to provide comparative extraction data on raw Lakwa-Rudra Sagar kerosene and straight raw Nahorkatiya kerosene in connection with the establishment of a new refinery in Assam.

Appliances

The work under this area, taken up partly at the request of Defence Departments and partly on its own initiative, aims at developing new components or modifying existing components or appliances for more efficient utilization of petroleum products under extreme conditions of low temperature and pressure at high altitudes. The following devices, developed by IIP, are under field trials: air-fuel mixture correction device for Willys and Nissan petrol engines for compensating power loss and saving of fuel; fuel rack adjuster for diesel engines for fuel saving and smoke reduction; bifuel governor for stationary engines to compensate power loss; and cold starting aid and bifuel control for automotive engines to compensate power loss.

Electronic instruments being developed to meet laboratory requirements include electronic tachometer, spark advance indicator, strain gauges for torque measurement, pressure transducers and combustion pickups.

Development of burners and heating and lighting appliances for defence and civilian use is also undertaken.

Analytical & Testing Methods and Facilities

Instrumental analysis: To determine the composition of petroleum products including trace elements, facilities have been established, e.g. gas chromatography, X-ray diffraction, mass spectrometry, infrared, ultraviolet and emission spectroscopy, atomic absorption spectroscopy, etc. Facilities have been established for the estimation of trace metals in oils, and for the analysis of petroleum fractions and used engine oils.

Performance evaluation of fuels and lubricants: Extensive engine testing facilities have been established for the evaluation of the performance of fuels and lubricants and certification of these products. At the instance of the Ministry of Defence, a test rig has been set up with Willys jeep rear axle for the evaluation of hypoid gear lubricants, particularly their load carrying capacity conforming to US MIL-L-2105 B specification. The performance of motor oils is assessed in terms of detergency and oxidation stability.

The engines include all the four configurations of the Caterpillar engine and its European equivalent, the Petter AV-1 engine, for evaluating detergency characteristics of heavy duty engine oils; the CLR engine and its European equivalent, the Petter W-1 engine, for evaluation of oxidation stability, bearing corrosion loss and sludge deposition characteristics. These facilities have proved to be of considerable use to the Defence Department.

As the Caterpillar and Petter AV-1 engine test techniques for the evaluation of the detergency of crankcase lubricating oils involve the use of original imported components for each test which are expensive, a test rig using indigenous Kirloskar AV-1 engine has been set up to replace tests on imported engines. A test bench using Villiers engine has been set up for evaluating oxidation stability and bearing corrosion tendencies of lubricating oils to replace tests on imported Petter W-1 and CLR test engines.

Vehicles fitted with two-stroke engines use petroil (petrol plus lube oil) mixture, and this poses problems such as spark plug fouling, port blocking, power loss and piston seizure. A test bench has been set up for developing a suitable performance test to evaluate lubricating oils for these engines.

The engine tests, though indispensable in the final check, are expensive and time-consuming. A project has been taken up to develop simple laboratory screening tests, which are faster and less expensive and expected to prove helpful in evaluating new oil formulations. The technique consists in splashing oil continuously onto a hot aluminium surface kept at constant temperature. Oxidation stability is assessed from the merit ratings on the aluminium surface after fixed time.

Rigs have also been set up to evaluate greases with regard to water wash-out characteristics, leakage tendencies and roller bearing performance.

Lubricity of aviation turbine fuel: Lubricity characteristics of aviation turbine fuels (ATFs) produced in Indian refineries are investigated. Comparative studies on different blends of non-hydrotreated and hydrotreated ATFs have been helpful in evolving suitable blends for regular use. A test rig for determining the lubricity of ATFs has been fabricated and a prototype has been supplied to the Madras Refinery.

Product Application/Utilization

The work under this area relates to the study of problems arising in the utilization of products. Barauni diesel fuel blended with coker products poses storage problems due to the formation of sludge. Different additives have been tried on long storage to study their effect on sludge formation according to DEF 2000 method. Work on some additives found suitable is in progress.

Kerosene deficit in the country is made up through imports. If the smoke point of kerosene is reduced from 20 to 18 mm in the IS specification, production can be increased by about 12%, resulting in a saving of foreign exchange of about Rs 2.2 crores. It is proposed to evolve a test, in addition to smoke point, for defining the performance of kerosene. Studies on optimization of the burner design for illumination are under way.

Basic Research

Separation of aromatics: Solvents containing sulphur are more efficient for separating aromatics in petroleum fractions. With a view to studying other potential sulphur group solvents suitable for the separation of aromatics from non-aromatics, the role of various functional groups in different organo-sulphur compounds on selectivity and solubility has been taken up for study.

Wear of engine parts, performance of fuels and adulteration of fuels: The object of the project is to assess the wear of engine parts with greater accuracy, and study the performance of fuels and lubricants. It is also intended to detect fuel adulteration using radiotracer techniques. Studies in progress relate to: Piston ring wear using a single cylinder Kirloskar AV-1 diesel engine in cold and hot starting conditions with oils of different viscosities; and lube oil consumption in IC engines using the BD 144A International Harvester tractor engine with three different types of oil control rings.

Protective film formation between lubricated sliding surfaces: To study the effectiveness of antiwear and extreme pressure additives on reducing metallic contact, the rate at which they act and the durability of protective films formed, a device consisting of a fixed metal ball resting on top of a rotating disc which dips into the test lubricant has been developed. The formation of complexes by the additives with aromatic hydrocarbons produces charge. Experiments with stainless steel surfaces indicate that the complex formation increases the load-carrying capacity. Further work is in progress.

Radiation polymerization of trioxane: In recent years polymerization processes like ethylene to polyethylene, trioxane to polyoxymethylene, etc. have been commercialized using radiation technique. Polyoxymethylene is increasingly used as a substitute for metals in engineering industry. Radiation polymerization of trioxane yields polyoxymethylene of desired properties and the process is more economical than the conventional ones. A gamma-ray chamber containing cobalt-60 of 2500 curie strength has been installed, and preparation of trioxane from paraformaldehyde is in progress.

Catalysis: A study of the mechanism of catalysis which would aid in the manufacture of catalysts used in refining and petrochemical industries is in progress. Facilities for investigating surface acidity, true and particle densities, adsorption and surface area measurements, pore size distribution, etc. have been developed.

Techno-economic and Preinvestment Studies

Market and feasibility studies, which are necessary before investment is made, are undertaken mainly at the request of the industry and government departments to enable them to take decisions on industrial projects.

Demand forecast of petroleum products: In collaboration with the Department of Petroleum and Chemicals, the institute constantly reviews the demand forecasts for petroleum products at regular intervals.

Other surveys carried out include regionwise demand and distribution of petroleum products, and demand forecast for petrochemical intermediates and products.

Process Evaluation, Process Design and Project Engineering

Work in this area is intended to assist the development of refining, petrochemical and other petroleum product-based projects.

The institute continues to provide technical consultancy to Nagpal Ambadi Petro-chem Refining Co. Ltd for the establishment of transformer oil and speciality oils project at Madras in the form of process design review, evaluation of base stocks, complete project engineering and supervision of detailed engineering. Other projects in progress are: Process package for naphtha hydrodesulphurization unit for Zuari Agro-chemicals Ltd, Goa; process design for hydrogenation of pyrolysis gasoline for the Indian Petrochemicals Corporation Ltd; computer programming for optimization of refinery processes; design calculations for the existing phenol extraction unit and for the production of high viscocity lube oils for the Barauni Lube Oil complex; and equipment costing for the Haldia Refinery.

Structure of Collagen

Although the basic chemical nature of collagen is well understood, the biological properties of the protein, such as control of synthesis and breakdown, stabilization of the fibrils and regulation of biological function are not well understood. The most important consequence of the triple helical structure of the collagen is that the amino acid side chains are primarily utilized for intermolecular interactions, the major function of collagen being the formation of fibrils. An attempt has been made by Smt. C. Gowri of the Central Leather Research Institute, Madras to measure the availability of strategic functional side chains in collagen and study their role in the biologic function of collagen. The investigations involved chemical modification of tyrosyl residues by enzymatic oxidation and reaction with tetranitromethane, detection of an active seryl residue by interaction with tosyl chloride and modification of histidyl residues by photo-oxidation using methylene blue. N-bromosuccinimide, pepsin and trypsin were used to cleave the polypeptide chains in order to gain insight into the location of the modified residues. The effect of modification on biologic properties such as fibril formation and stabilization was studied. The results suggest that histidine, serine and tyrosine residues in collagen influence certain biologic properties such as cross-linking and stabilization. A new basic amino acid, lysinoalanine, was detected in alkali treated collagen, which suggests that this amino acid may serve as a cross-link in collagen. These observations have not been previously reported.

Smt. Gowri was awarded the Ph.D. degree (1971) by the Madras University, Madras for her thesis based on the studies.

Ceramic Water Filter Candles

Ceramic water filter candles are extensively used for obtaining filtered drinking water free from both suspended impurities and harmful water-borne bacteria such as those of cholera, dysentery, typhoid, etc. These candles, imported under the trade name 'Berkfeld' filter candles, are made from kieselguhr, a special type of cellular silica which is not available in India in desired quality and quantity. It is estimated that at least one lakh such candles are imported annually, involving a foreign exchange of Rs 10 to 15 lakhs. A process for making such ceramic filter candles using indigenously available ceramic materials has been developed by the Central Glass & Ceramic Research Institute (CGCRI), Calcutta. Several batches of commercial size candles made at the institute were tested for their quality at the Indian Institute of Hygiene and Public Health, Calcutta, the Institute of Child Health, Calcutta, the Central Public Health Engineering Research Institute, Nagpur and Indian Institute of Experimental Medicine, Calcutta, and their rate of filtration and capacity of filter water free from bacteriological contamination were found to be highly satisfactory.

The manufacturing cost of the Berkfeld type indigenous filter candles would be about Rs 5 per piece while the cost of imported candles is about Rs 15 each. The present market price of the imported candles ranges from Rs 40 to Rs 90 per piece. Indigenous production and availability of such candles at moderate cost would bring the research benefit within the reach of middle class people and would go a long way towards maintenance of public health wherever scarcity of drinking water and water pollution cause serious health problems. These candles are capable of filtering water clear and free from bacteria, irrespective of the source of supply.

'Katadyn' type candles used by the defence personnel in Katadyn pocket water filter pump have also been developed by the institute. These candles were entirely imported so far, involving a foreign exchange of about Rs 14 lakhs per annum. The CGCRI-made candles of this type have been tested under pressure at a defence laboratory and found to be highly satisfactory for obtaining potable bacteria-free water supply in difficult forward locations.

Anti-Fungal Emulsion

Mildew growth on leather goods and footwear during the monsoon months in India is a common feature affecting their export. The Central Leather Research Institute (CLRI), Madras has developed a cationic fungicide emulsion which can be incorporated into the leather at the time of manufacturing either the leather article or footwear. The emulsion gets absorbed into the leather when it is dipped into water to make it pliable for stitching. Leather samples, including footwear, so treated were tested over a long period and showed resistance to mildew at varying temperatures and humidity.

The performance of the fungicidal solution will be evaluated in commercial establishments exporting leather goods.

Structural and Conformational Studies in Terpenoids and Related Compounds

Some of the minor constituents of neem (*Azadirachta indica*) oil, viz. nimbinin, deoxynimbinin, dideoxynimbinin and vepinin, have been isolated and purified and their structures determined by Shri B. M. Sawant, a guest worker working at the National Chemical Laboratory, Poona, under the guidance of Dr C. R. Narayanan of the laboratory. The carbonyl group of secondary amides forms one of the fundamental units of peptides. The conformation of this group has been determined in rigid cyclic systems as well as simple cyclohexanes and in a long chain hydrocarbon. The conformation has been found to be the one in which the carbonyl group nearly eclipses the secondary hydrogen atom concerned. This would be of some fundamental significance in calculating the energy required for the conformations finally adopted by peptide chains in enzymes and other systems.

Shri Sawant was awarded the Ph.D. degree (1971) by the Poona University, Poona for his thesis based on the studies.

National Metallurgists' Day Awards

Shri A. K. Chakravarti of the Central Fuel Research Institute, Dhanbad and Dr M. R. K. Rao of the National Metallurgical Laboratory, Jamshedpur are among the ten recipients of the Ninth National Metallurgists' Day awards. The awards were presented at a function held at the Indian Institute of Science, Banglaore on 14 November 1971. The two scientists received a cash award of Rs 2000 each.

Shri Chakravarti received the award for his contributions to fuel technology relating to metallurgical industries, and Dr Rao for his contributions in the fields of refractories, submerged arc welding fluxes and slags.

Shri A. K. Chakravarti

Shri Chakravarti, who has been working for about 20 years on various aspects of metallurgical fuel making, has rendered valuable assistance in the planning and projecting work of a dozen coal washing plants in India. Significant contributions made by Shri Chakravarti in metallurgy include development of: (1) cheap and simple specific gravity indicator for coal washeries; (2) pneumatic size classifier for selective preparation of coal for coke making; (3) cheap process for the production of domestic, industrial and metallurgical fuel, utilizing byproducts (middlings, rejects and sinks) of coking coal washeries; (4) process for the manufacture of domestic and industrial fuel, utilizing undersized coke (coke breeze) from coke ovens; (5) process for simultaneous upgrading and dewatering of small size coking coal; (6) process for the production of moulded shapes as improved charge for ferro-silicon manufacture; and (7) rapid method for the simultaneous determination of ash and moisture of coal washery products.

Shri Chakravarti has to his credit over 50 research and review papers, a number of technical reports and seven patents.

Dr M. R. K. Rao

Dr Rao has been responsible for research and development and industrial use of submerged arc welding fluxes for welding low alloy and mild steels used in the fabrication of boilers, pressure vessels and heavy structurals. Such fluxes have replaced imported products. Phase equilibrium studies made by Dr Rao on high alumina lime-magnesia-alumina-silica systems have led to significant contributions in refractory technology. Among the other significant contributions of Dr Rao and his colleagues are: (1) development of basic refractories from indigenous chromites, magnesites and basic rocks; (2) utilization of Indian dolomites as raw material for the manufacture of stabilized dolomite and L-D linings; (3) mineralogy and microstructure of refractories; (4) hot stage microscopy of refractory materials and blast furnace slags; and (5) development of high alumina refractory cements and castables.

As a Colombo Plan fellow, Dr Rao underwent training in mineralogy and refractories at the Mines Branch of the Department of Mines, Energy and Resources, Ottawa during 1955-56. He is an Associate Member of the Institute of Ceramics (UK) and a member of the Indian Ceramic Society.

Dr Rao has to his credit over 50 research papers, reviews and reports and five patents.

International Hydrological Decade

Shri S. Banerji, Secretary, Indian National Committee for International Hydrological Decade (IHD), attended the IHD Working Group on Exchange of Information and Publications from 16 to 19 November 1971 and the Coordinating Council of the IHD from 22 to 27 November 1971 respectively at Paris. The International Hydrological Decade is a ten-year (1965-1974) programme of Unesco for scientific assessment and rational management of the water resources of the world. The programme consists of projects on networks, inventories and water balances, research, education and training and exchange of information and publications.

Shri Banerji was re-elected the chairman of the working group; he has been holding this office from the very first session in 1966. The working group drew up a schedule of publications to be brought out by Unesco and also laid down priorities and the types of technical literature which Unesco should publish for disseminating research results in the field of hydrology. Shri Banerji was also requested to draw up a model research report on one of the aspects of hydrology.

Shri Banerji represented India in the IHD Coordinating Council as leader of the Indian delegation. He stressed the need for more efforts for the advancement of hydrology in the developing countries. The Council agreed to sponsor the International Postgraduate Diploma Course in Hydrology at Roorkee and was informally assured of liberal Unesco support. The Council also recommended to Unesco to cosponsor the symposium on Study of Groundwater Resources, proposed by India, to be held in February 1973. The need was stressed for coordination between National Committees set up in the various countries for different programmes, e.g. Hydrology, Environmental Studies, etc. and advocated that the hydrological aspects of these programmes be entrusted to the National Committees for IHD. The Council was glad to know that India was considering the setting up of a permanent National Hydrological Board. The International Hydrological Programme to be launched after the Decade comes to a close in 1974 was discussed with particular reference to data collection and achieving water balance. These items have been already included in the objectives of the proposed National Hydrological Board.

PROGRESS REPORTS

CFTRI Annual Report: 1969

The annual report of the Central Food Technological Research Institute (CFTRI), Mysore for 1969, published recently, shows the institute's concerted efforts to achieve its basic objective of economic progress through research, development and technical assistance in food science and technology. Technical assistance was provided to food processing industries for raising their productivity, reducing losses, improving nutritional standards and setting up new industries. Besides project-wise reports, the annual report contains a summary highlighting the work in the following areas of food science and technology: storage of foodgrains; cereals and pulses; oilseeds and protein foods; fruits and vegetables; meat, poultry and fish; spices and flavour; tea; sensory evaluation; microbiology; mycotoxins; applied nutrition and dietetics; and biochemistry.

Foodgrain storage: Integrated techniques for rodent control, viz. application of poison baiting, repellent spraying and burrow fumigation were tried in several villages to assess their effectiveness on a field scale. Non-toxic grain protectants like activated bentonite and kaolinite, and a formulation based on metahydrogen-halloysite have proved successful in the laboratory for control of fungi in rice.

Antifungal agents like Thiram and Captan have shown anti-feeding and chemosterilizing effects respectively on *Sitophilus oryzae*. Methods were developed for estimating Thiram residues in foodgrains and for quick detection of Lindane and Captan. Significant reduction in microbial load was noticed by exposing the foodgrains to carbon dioxide or nitrogen. Methyl iodide was found effective for controlling internal fungi in sorghum without affecting viability.

Cereals and pulses: The rubber roller sheller installed in a rice mill was tested and found to increase milling yield of rice by 1% and to reduce total breakages by 3-4%. The destoner unit, also installed in this mill, completely eliminated stones from rice, thereby yielding a better grade of broken rice. The drying of parboiled paddy by the two-stage technique in a 5-ton L.S.U. drier was tested on a commercial scale at the Modern Rice Mill, Memari, and found effective; milling breakages were less than 5%.

Conditions were standardized for polishing jowar in a Dandekar rice mill to ensure fuller utilization of the idle milling capacity and to make the mills more productive. Polished jowar can be used in breakfast dishes and some sweet preparations. The technology of milling legumes has been improved. Introduction of a new hot-air drier, designed and fabricated at the institute, has been helpful in conditioning the grain for easy removal of husk. The new [illegible]hal splitter reduces breakage. Pilot plant scale trials have shown that milling outturn could be raised by 10-12%.

Oilseeds and protein foods: Prepress extraction of dehusked sesame seeds with food grade hexane yielded a flour (32% of black seeds) containing 52-56% protein and 0.5-1.0% oil. The techniques developed for the dehusking of mustard and removal of sinigrin, the toxic principle, from the meal have been successfully tested in pilot scale trials. The presence of growth inhibitors, other than sinigrin, in the mustard flour has been indicated in feeding trials. The essential amino acid composition of mustard seed protein compares well with FAO reference pattern.

Fruits and vegetables: Studies on the preservation of mangoes and bananas in fresh state to extend their inland as well as overseas trade were intensified. Work on the control of fungal spoilage in mangoes has been extended, and fungicides like Alisan-50, Thiram and Captan proved effective when included in the hot water dip treatment.

Hydrocooling of green banana hands, preharvest spraying with maleic hydrazide and exposure of green bananas to nitrogen were found effective in maintaining cold stored bananas in frozen condition up to 25 days. Gamma irradiation was found effective in extending the storage life of fresh oranges. It has also shown promise in reducing sprouting in onion and garlic bulbs. The improved techniques for the production of pectin, reported earlier, were tested on papaya, orange and apple pomace, and found suitable for the production of solid and liquid pectin with low ash content.

Meat, poultry and fish: The economics of producing meat and vegetable based sausages with different ratios of meat and fat has been worked out. The cooked product costs about Rs 8/kg and can be stored up to 24 days in a refrigerator.

The effects of icing freshwater fish immediately after catch or after a few hours were studied; fishes subjected to both the treatments remained acceptable for 4 weeks under refrigeration. Several types of fish are being tested as sources of protein concentrates. Pink perches (*Synargis [illegible]ponicus* and *S. tolu*), which are good shoaling fishes, yielded white coloured products which can be used in making milk-like emulsions for infant feeding.

Spices and flavour: A colorimetric method was developed for estimating the pungent principles in black pepper. Preliminary studies have shown that satisfactory yields of oleoresin can be obtained when coarsely powdered dry ginger loosely packed in columns is subjected to cold solvent extraction.

Tea: A variety of unblended teas with different characteristics was analysed; the data confirmed that poorer quality teas had higher content of carbonyl compounds which influence the flavour of tea. Enzymes appear to be involved in the formation of carbonyl componds during fermentation. Caffeine-polyphenol complex has been solubilized to the extent of 67% by extracting tea with chloroform.

Microbiology: An acceptable sherry-like product from raisins of *Anab-e-Shahi* grapes, wine and brandy from banana and brandy from dates have been prepared in the laboratory. Amyloglucosidase, amylase and pectinase were produced on batch scale in the 'koji' room. Maximum pectinase enzyme precipitate (which also had the highest activity) could be recovered by the addition of calcium chloride to the aqueous extract of mouldy bran. One strain of *Aspergillus flavus oryzae* was found to be a potential producer of protease; its carbon and nitrogen requirements were worked out.

Mycotoxins: A yellow, strongly labelled compound was isolated from the culture medium of resting cells of *A. flavus* when it had been supplied with labelled acetate. The culture broth of *A. candidus* was found to contain a potent trypsin inhibitor.

Applied nutrition and dietetics: The nutritive value of a low cost protein food based on *ragi* flour, peanut flour and chickpea flour (65:25:10) was tested and found to improve by supplementation with limiting amino acids; this food could be used up to 25% level with cereals to overcome the deficiencies in poor Indian diets. Multipurpose food was found to show varying degrees of supplementary value when calorie intake in poor Indian diets was restricted. By supplementing with limiting amino acids, the nutritional qualities of Indian diets based on rice, *ragi* and wheat could be improved.

Biochemistry: Studies on the bacterial metabolism of amino acids were continued and enzymes involved in the conversion of diaminobutyric acid into aspartic-*beta*-semialdehyde and the further conversion of the aldehyde into aspartic acid were partially purified. The latter has been shown to be an —SH enzyme. Proteins containing N-acetyl-L-phenylalanine residues at the N-terminal end were isolated from *Esch. coli* K-12 and the enzyme responsible for acetylating L-phenylalanine in cell-free extracts of the bacteria was purified. The presence of a transacylase was also demonstrated.

Research utilization: The process for the manufacture of spray-dried egg powder was released to industry and a plant which can manufacture 150 tonnes of egg powder per annum is being erected in Maharashtra; this will meet the defence requirements. Four more processes, viz. production of Durobase formulation, pest-proof emulsion, distillation of cardamom oil and fruit bars, were released to industry during the year.

Commercial production of Durofume fumigant combination, developed at the institute for disinfestation of bulk stocks of foodgrains stored in godowns and urban warehouses, was started during the year.

One hundred and eight papers were published and four patents were filed.

PROCESSES & PRODUCTS READY FOR COMMERCIAL UTILIZATION

Tert-Butylcatechol

Tert-butylcatechol is used as a stabilizer or polymerization inhibitor in the manufacture of synthetic rubber.

At present there is no indigenous production of this compound and the entire requirements are met through imports. However, no reliable data regarding the demand and import of this material are available. It is reported that Synthetics and Chemicals Ltd, Bareilly, who are the main consumers of this item, require about 18 tonnes per annum of this material. The estimated demand by 1974 is of the order of 24 tonnes per annum.

A process for the manufacture of *tert*-butylcatechol starting from *tert*-butyl alcohol and catechol, has been developed by the National Chemical Laboratory (NCL), Poona. The work has been conducted on a 10 kg/batch of the material and data regarding the consumption of various raw materials and utilities for every kilogram of the finished product have been collected. The yield, based on catechol, is 80% of the theoretical value. The characteristics of the product are: colour, light brown; mp, 48-50°C, and purity, 95-97% (VPC analysis).

The product prepared at NCL has been tested by Synthetics and Chemicals Ltd, and found satisfactory.

The optimum plant capacity is about 25 tonnes per annum.

The raw materials are *tert*-butylalcohol, catechol, benzene and sodium carbonate. Of these, catechol and *tert*-butylalcohol will have to be imported. There is a possibility in the near future of the establishment of catechol industry in the country based on the crude catechols available from Neyveli Lignite Corporation Ltd, Neyveli.

The main items of plant and machinery like stainless steel reactor, flame-proof motor, condenser, receivers, packed column, extract storage vessel and high vacuum distillation assembly are indigenously available.

For a plant of capacity of 25 tonnes per annum, the total investment is expected to be Rs 5.00 lakhs (Rs 1.60 lakhs on plant and building and Rs 3.40 lakhs as working capital). The cost of production of unpacked material comes to Rs 27/kg.

Further particulars may be had from: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

Butyl Titanate

Butyl titanate is used in insulating varnishes, fire and rust-proof paints. It is also used as a catalyst in polymerization and condensation reactions.

The exact demand for this material is not known and its import figures are also not available.

The main use of this item is in insulating varnishes. It is expected that about 15 tonnes per annum will be required by Dr Beck & Co., Poona alone.

Butyl titanate is prepared by the reaction of titanium tetrachloride with *n*-butanol in a suitable solvent. The processing of the mixture gives butyl titanate.

The process for the production of butyl titanate on 10 kg/batch scale has been standardized by the National Chemical Laboratory (NCL), Poona, and data regarding the requirement of raw materials like butanol, titanium tetrachloride, etc. have been collected.

The product has the following specifications:

	Standard specifications	Characteristics of NCL product
Colour	yellow to yellowish brown	yellow to yellowish brown
Sp. gr.	0.99-1.01	1.00-1.01
Viscosity	25 sec. [4 mm cup at 20° (approx.)]	24-27 sec [4 mm cup at 20°]
Ash (TiO_2)	20 ± 1% (theoretical 23.4)	22.5—33%

A few kilograms of the product were prepared by the laboratory and found to be suitable for neat varnishes.

The optimum capacity of the plant for the production of butyl titanate has been suggested as 20 tonnes/annum.

The major raw materials required for the manufacture of butyl titanate are butanol and titanium tetrachloride. Titanium tetrachloride will have to be imported. Other raw materials are available in the country.

The main items of plant and equipment like glass-lined reactor, enclosed pressure filtration unit made of stainless steel or M. S. coated stainless steel, centrifugal and steel distillation unit are available in the country. Flame-proof motors will be needed as a measure of safety.

The total cost of the plant for producing 20 tonnes of the product per annum has been estimated at Rs 3 lakhs (Rs 1.60 lakhs as fixed capital and Rs 1.40 lakhs as working capital). The cost of production works out to Rs 17.40/kg.

Further particulars may be obtained from: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

PATENTS ACCEPTED

Indian Pat. 125852

Injected beam type crossed-field tube with improved Kino long gun

G. S. Sidhu, CEERI, Pilani (& R. P. Wadhwa, Bharat Electronics Ltd, Bangalore)

This invention relates to an improvement in the Kino long gun commonly used to form an electron beam for use in the vacuum devices such as an injected-beam crossed-field device whether it is an amplifier or an oscillator. For high power applications, it is advantageous to use a Kino long gun because the large cathode width and large beam compression allow high dc beam current density. The design of a Kino long gun is based on a space charge flow solution and it is possible to calculate the cathode current density and total current from the gun. But the Kino long gun has the disadvantage that it has a long accelerating region of slow acceleration for attaining the desired beam voltage. This results in a large diocotron gain which causes the beam thickness and noise to grow rapidly in the slow accelerating region.

It has been shown that by providing a fast accelerating transition consisting of two sets of parallel electrodes at the exit of the abbreviated Kino long gun, and by applying appropriate voltages at the electrodes of the fast accelerating transition for a fixed magnetic field, the following advantages result: (1) Electron beams with cathode current density varying over a wide range can be accelerated to the desired beam voltage over a wide range with almost negligible diocotron gain with optimum exit conditions. (2) Electron beams of widely different cathode current densities are obtained and launched under optimum conditions at desired level and beam velocity. This property can be used in crossed-field tubes to obtain amplitude and frequency modulation.

PATENTS FILED

132762: Production of isobutyraldehyde from isobutyl alcohol, G.P. Sastry, M. Chakravarty & M. S. Iyengar—RRL, Jorhat.

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132940: Mini lawn mower, S. K. Rao, S. C. Sarmah, N. K. Gupta, A. C. Khazanchi & M. S. Iyengar—RRL, Jorhat.

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133261: Starter fluid induction device for cold starting of I. C. engines, R. B. Gupta—IIP, Dehra Dun.

PATENTS SEALED

112777: Process for the recovery of potassium salts from molasses distillery spent wash liquor using ion-exchange technique, H. M. Bhavnagary, R. Ramaswamy & N. R. Krishnaswamy — CSMCRI, Bhavnagar.

116648: Chlorine tablets, B. N. Pathak & K. R. Bulusu—CPHERI, Nagpur.

116762: A process for the utilization of mammalian intestines for the manufacture of absorbable surgical catgut/suture/ligature 'plain and chromic", S. K. Barat & M. Kumar—CLRI, Madras.

116997: Iodine tablets, B. N. Pathak, K. R. Bulusu & S. B. Dabadghao—CPHERI, Nagpur.

117403: Preparation of water-thinnable emulsion paints from linseed oil, S.L. Kapur & S. H. Bakshi—NCL, Poona.

118916: A process for stabilization of ferro-silicon, P. P. Bhatnagar & R. N. Misra—NML, Jamshedpur.

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Creation and Transfer of Metallurgical Know-how :

UNIDO Workshop at NML

An international workshop on Creation and Transfer of Metallurgical Know-how, organized by the United Nations Industrial Development Organization (UNIDO) was held at the National Metallurgical Laboratory (NML), Jamshedpur from 7 to 11 December 1971. The workshop discussed problems concerning the difficulties, modus operandi and objectives for the creation of specialized metallurgical expertise and technical know-how, and prerequisites for the establishment of metallurgical industries in developing countries. The participants at the workshop included nine experts from various countries, viz. Hungary, West Germany, USA, UK, Japan and India, besides fellows from developing countries, viz. Turkey, UAR and Argentina. Some 25 metallurgists from Brazil, Japan and Hungary and representatives from the Central Engineering and Design Bureau of the Hindustan Steel Ltd, Heavy Engineering Corporation, Engineers India Ltd, and experts from private sector industries in India acted as observers. Representatives from UNIDO at the workshop included Dr L. C. Correa da Silva, Chief, Metallurgical Industries Section, and Dr B. R. Nijhawan, Senior Inter-Regional Adviser, who was also the Officer-in-charge of the workshop.

In his inaugural address, Shri S. K. Nanavati, Managing Director, Tata Iron & Steel Co. Ltd, Jamshedpur, called for an accelerated tempo of work in acquiring metallurgical know-how and in developing indigenous processes.

Prof. V. A. Altekar, Director, National Metallurgical Laboratory, Jamshedpur, said in his welcome address that the workshop was bound to provide adequate guidelines for evolving the mechanism for the creation and transfer of metallurgical know-how.

In his message to the workshop Mr I. H. Abdel-Rahman, Executive Director, UNIDO, expressed the hope that as a result of the deliberations of the workshop and with the collaboration of the advanced countries, a new group of projects for technical assistance would be formulated by UNIDO for the benefit of developing countries. The main aim of these projects would be the creation of metallurgical know-how in these countries and absorption of know-how from those countries which are well advanced in the metallurgical field. He further hoped that the areas where the existing nuclei of industrial metallurgical know-how and technical consultancy services and R & D centres in the developing countries require expansion, diversification and specialization would be identified and that UNIDO would be able to augment these services.

Mr N. K. Grigoriev, Director, Industrial Technology Division, UNIDO, stated in his message that apart from reducing the import of metallurgical expertise and technology on a repetitive basis, the creation and utilization of metallurgical know-how within a developing country would lead to self-sufficiency and acceleration in the industrialization process. He hoped that the workshop would focus attention on the means to stimulate the creation and transfer of metallurgical know-how and expertise for the benefit of developing countries.

Dr Y. Nayudamma, Director General, Scientific and Industrial Research, pointed out in his message that a research and development infrastructure for adaptation and innovation of metallurgical technology relevant to the main raw materials of the countries is essential to the future progress of the developing nations. He expressed the hope that the help and assistance of UNIDO in creating conditions of transfer of metallurgical technology from the advanced to the developing countries on favourable terms would help the latter to generate technological competence in this field.

Principal recommendations of the workshop are as follows: (1) Developing countries should achieve progressively increasing technical self-sufficiency. (2) Repetitive import of metallurgical know-how should be avoided and where technology is imported it should be improved upon and modified to indigenous conditions to develop local talent. (3) UNIDO should act as antenna in ensuring that the metallurgical know-how thus transferred leads to the development of technical consultancy services in the developing countries themselves. (4) UNIDO should assist in the formulation of development programmes of metallurgical industries and techno-economic evaluation of new metallurgical projects and sponsor the preparation of detailed project reports and should catalyze the establishment of centres of metallurgical technology in the developing countries. (5) UNIDO should assist in the formulation of these metallurgical centres and in the expansion of such centres in specialized fields where these already exist. (6) UNIDO should also assist in the training programmes of developing countries so that cadres of trained metallurgists are created to effectively implement the know-how transferred from the developed to the developing countries. (7) Metallurgical technology thus developed within a country should lead to a chain reaction growth of the mineral and metallurgical industries based on sound techno-economic parameters. (8) An international group of metallurgists should be set up to further the promotion of metallurgical technology and specialized technical know-how from the developed to the developing world. (9) While it may be necessary to provide foreign experts and technical consultancy services to the developing countries, local talents must be developed and harnessed so that these countries stand on their own legs and be technically self-sufficient. (10) Technical experts and consultancy services should be provided by UNIDO in order to develop technical consultancy services in the developing countries themselves for the growth and development of their metallurgical industries.

CURRENT RESEARCH PROGRAMMES : CFRI

The research programmes of the Central Fuel Research Institute (CFRI), Dhanbad for 1971-72 comprise 113 projects under the following 14 groups: Coal quality assessment and geological studies; Natural solid fuels—preparation; Carbonization; Manufacture of solid fuels; Industrial carbons and carbon products; Combustion, industrial furnace and kilns; Gasification and gaseous fuels; Chemicals from by-products of carbonization and gasification; Synthetic liquid fuels; Agro-biological applications of coal and its derivatives; Fundamental studies relating to fuel technology; Analysis, testing and instruments; Operations research; and Miscellaneous projects.

Coal Quality Assessment and Geological Studies

The seven Coal Survey Laboratories of CFRI continue (i) to carry out physical and chemical surveys of working seams and of bore hole coal cores from virgin areas and (ii) to study the metamorphism and correlation of petrographic properties. The suitability of coals for direct use as domestic fuel, composition of mineral matter, washability characteristics, and weathering of coal-stacks are investigated. Also investigated are the utilization of slacks in briquetting and the effect of storage on caking properties.

A monograph on Indian coals is being compiled. Resources survey for a super thermal power station and utilization of Kutch lignite in Gujarat are other important projects on hand.

Natural Solid Fuels : Preparation

Seven projects are under way: (1) Correlation of petrographic properties with coal preparation; (2) Development studies on cyclo-flotation; (3) Upgrading and dewatering of small and fine coal by oleo-flotation in 250 kg/hr testing plant; (4) Upgrading and dewatering of inferior coals by spherical agglomeration; (5) Pneumatic separation for selective preparation of coal and setting up of a 5-tonne/hr plant; (6) Performance study of the Kargali washery of the National Coal Development Corporation; and (7) Agglomeration of crushed middlings and rejects from coking coal washeries for making domestic fuel.

Based on the results of laboratory studies, a laboratory unit has been designed and fabricated for studying the possibilities of upgrading coal fines by cyclo-flotation. An agreement has been signed with a private firm for the scaling up of the oleo-flotation process, which has been patented.

Projects to be taken up include: (1) upgrading of high-ash coking coals having different cleaning characteristics; (2) upgrading of oil-shale by phase separation; (3) beneficiation studies for Monidih Washery Projects; (4) pelletization of slurries and coking coal fines for preparing high density feed to coke ovens.

Carbonization

Tests for optimizing coal blends from new sources for the Bhilai and Rourkela Steel Plants are on hand on sponsored basis. At the instance of the Bokaro Steel Ltd the Institute has taken up investigations on the sources of coal supply for its second stage of production. Other projects on hand relate to stamp charging of coals and laboratory and pilot plant studies on devolatilization of fine coals with solid heat carrier for the production of rich gas and low V.M. char.

Manufacture of Solid Fuels

Important projects in this area concern the production of coke for ferro-alloys manufacture and for use in electrothermal industries and bulk production of base material for cathode block for aluminium industries. Production of formed coke on 1 tonne/hr continuous pilot plant for metallurgical, industrial and domestic use and design and erection of 2 tonnes/hr fluid bed carbonization pilot plant are the other projects being continued.

Industrial Carbons and Carbon Products

Investigations are being carried out for obtaining carbon black and hydrocyanic acid from coal and for finding a substitute for detonator charcoal. Following the successful development of a process for converting coal, lignite and coconut shell to active carbon, the suitability of other raw materials such as bagasse, groundnut shell and rice husk for the production of active carbons is being investigated.

Methods for the production of cathode block, anode block, carbon brushes, battery rods and soderberg electrodes are being investigated.

Combustion, Industrial Furnace and Kilns

Studies on the combustion characteristics of Indian coals under pulverized fuel firing, and under fluid-bed conditions, and on the design and development of soft coke fired domestic chullahs with chimneys are being continued. Fuel efficiency studies and tests are carried out on fuel problems of industrial units on request.

Gasification and Gaseous Fuels

Projects on hand relate to: (i) gasification of coal under pressure for the production of town gas and synthesis gas, (ii) conversion of coal to synthesis gas in suspended bed, (iii) steam-iron process for the manufacture of pure hydrogen, and (iv) development of superior shift conversion catalysts.

Projects to be undertaken include: (i) an integrated process for carbonization, gasification and combustion of coal in fluid bed, and (ii) production of hydrogen by steam-iron process by fluid bed technique.

Chemicals from Byproducts of Carbonization and Gasification

Identification and isolation of useful byproducts and their economic recovery combined with interconversion of less useful components to more useful chemicals are the chief objects of this group comprising as many as 22 projects.

Ammoxidation of hydrocarbons to their corresponding nitriles, production of acetylene by high temperature pyrolysis, direct conversion of coal resin from coal tar fractions, etc. are some of the projects which merit mention. Some processes completed successfully on a laboratory scale are being scaled up for commercial exploitation. Contracts have been signed with consulting engineering firms for the processes relating to the production of 4-cyanopyridine from 4-picoline, benzaldehyde and benzoic acid from toluene, etc.

Projects to be taken up include: (i) hydrodealkylation of alkylated aromatics, (ii) recovery of chrysene, perylene and pyrene from coal tar sources, and (iii) production of diphenyl and chlorodiphenyl from benzene.

Synthetic Liquid Fuels

Studies on the physico-chemical properties of iron sulphide catalyst, kinetics of coal hydrogenation in the presence of solvent or vehicle oil, blending possibilities of coal oil with natural petroleum crude, continuous bench-scale unit for hydrogenation of coal-oil paste (1 kg/hr) and design of coal oil slurry hydrogenation unit (50 kg/hr) are under way in connection with the conversion of Assam coals to oil and chemicals. A techno-economic feasibility report on the project is being prepared. Other important projects include: F.T. synthesis, oxo-synthesis and setting up of a multipurpose catalytic cracker.

Agro-biological Applications of Coal and its Derivatives

Efficacy studies of coal fertilizer and nitrification studies under laboratory and green house conditions are on hand. Possibilities of obtaining protein from F.T. wax and methane using single-cell bacteria and microbial degradation of coal are being investigated.

Fundamental Studies Relating to Fuel Technology

Fundamental studies on hydrogen production by steam-iron process in fluid bed and on catalysis with special reference to iron oxide catalysts are in progress. Solvent extraction of coal is being tried with special reference to Assam coals for hydrogenation and for the production of de-ashed coals. Electrochemical reduction of coal is another important project under investigation.

Analysis, Testing, Instruments and Miscellaneous Projects

Technical services are rendered to industry by way of analyses of coal, coke, oil, etc. Projects on hand or to be taken up include: investigations on the grindability index of coals; development of a standard for smokiness; and detection and estimation of trace contaminants in urban atmosphere.

Operations research projects receiving the attention of the institute relate to: development of a simple method of coal sampling; assessment of requirements and availability of coal for the proposed Power Station of DVC; survey, planning and rational utilization of energy sources; and relationship between abrasiveness and grindability of coal.

Utilization of fly-ash for the production of bricks is also being investigated.

Integrated Project for Coal Blending, Pig Iron Production and Power Generation at Haldia

The Central Fuel Research Institute (CFRI), Dhanbad has prepared a technical report concerning the setting up of an integrated project at Haldia for meeting the requirements of the coke ovens of the five proposed steel plants at (i) Vishakhapatnam, (ii) Salem, (iii) Hospet, (iv) Haldia, and (v) Paradip. The requirements of the first three plants are proposed to be met in the first phase and of all the plants in the second phase.

The project envisages in the first stage drawing of raw coals from various sources which after washing will be blended for supply to the coke ovens. The coal requirements (5.4 million tonnes in Phase I and 10.8 million tonnes in Phase II) are proposed to be met from seams V-IX and X and above from Jharia coalfield (Group A), Chanch, Ramnagar-Begunia-Laikdih seams (Group B) and Sanctoria, Dishergarh, Poniati and Koithee seams of the Raniganj coalfield (Group C). The proportion of the blend will be 45 : 35 : 20 of Groups A, B & C respectively. Blended coal will be despatched to the steel plants by ships which on their return journey will carry iron ore for blending at the various coastal steel plants. The coke ovens of all the plants will have the same blend as their charge. The middlings obtained are proposed to be utilized in power generation. Two and a half million tonnes of middlings will be obtained in Phase I, which can be used for generating 800 MW of power. Phase II will yield approximately 5 million tonnes of middlings with a potential power generation of 1300 MW.

In the second phase, a coke oven along with a pig iron plant is planned. In addition to meeting the demands of the pig iron plant, the coke oven (3.2 million tonnes) will be able to export 1 lakh tonnes of coke annually. A tar processing plant will also be set up for obtaining phenolics, tar bases, aromatics, pitch, etc. for ancillary chemical industries.

Of the entire gas produced in the coke ovens, 360×10^6 Nm^3 will be required for underfiring the ovens and the rest after meeting the requirements of a chemical complex and other ancillary industries may be either piped to Calcutta or used as an additional source of hydrogen.

PROGRESS REPORTS

NML Annual Report: 1969-70

The annual report of the National Metallurgical Laboratory (NML), Jamshedpur for 1969-70 records the steady progress the laboratory has made in its multiple research and development efforts in the various disciplines of metallurgy. The report shows the increasing involvement of the laboratory in the problems of the industry. Twelve major projects were investigated under the sponsorship of industries and government departments. Seventy-five project reports were furnished following the successful completion of the projects.

At the instance of the National Mineral Development Corporation (NMDC), detailed studies on crushing, screening, grinding and pelletization of an iron ore sample from Donimalai mines (Mysore) were carried out and a report was furnished; the data were required by NMDC for setting up a pelletization plant at the mine site. Beneficiation and pelletization studies on a synthetic sample of iron ore fines from Bailadila deposit were taken up with the objective of of setting up a pelletization plant. The sample (64.5% Fe, 2.1% SiO_2 and 3.3% Al_2O_3) was subjected to jigging and on cleaning once, the concentrate (71% by wt) assayed to 67.5% Fe, 0.6% SiO_2 and 1.5% Al_2O_3, with a recovery of 74.9% Fe. Batch pelletizing tests under varying conditions and heat hardening of the pellets are in progress.

Pilot plant studies were carried out on the recovery of copper, nickel and molybdenum from a sample of uranium ore (supplied by the Uranium Corporation of India Ltd) assaying to 0.14% Cu, 0.17% Ni and 0.21% Mo. The studies were aimed at selectively floating molybdenite employing fuel oil and cresylic acid in combination with or without sodium cyanide for depressing the sulphides of copper and nickel followed by the recovery of Cu and Ni minerals by conventional xanthate flotation. Five cleanings of the rougher molybdenum concentrate using cyanide yielded a a cleaner Mo concentrate assaying to 31.54% Mo, 1.1% Cu and 0.35% Ni with recoveries of the order of 45.1% Mo, 0.2% Cu and 0.1% Ni. One cleaning of the rougher Cu-Ni concentrate produced a cleaner concentrate which when mixed with cleaner Mo tails assayed to 3.28% Cu, 2.67% Ni and 0.22% Mo, with recoveries of 45.9% Cu, 30.5% Ni and 20.4% Mo.

Flotation of a low grade galena ore (Agnigundala, Andhra Pradesh), supplied by the Geological Survey of India and analysing to 6.2% Pb, 1.87% S and 11.5 g/tonne of silver, resulted in a rough concentrate assaying to 60.4% Pb, which on one cleaning improved in grade to 73.9% Pb, with a recovery of 95.2%. The concentrate was found suitable for extracting lead which contained silver as a valuable byproduct.

At the instance of the Geological Survey of India, beneficiation studies were carried out on a sample of low grade Cu-Pb-Zn ore from Dariba-Rajpura area (Rajasthan), assaying to 0.99% Cu, 4.8% Zn, and 3.7% Pb. Bulk flotation of Cu-Pb minerals followed by repeated cleanings yielded Cu and Pb concentrates containing 24.6% copper and 63.49% lead with recoveries of the order of 70.5% and 92.2% respectively. Activation of sphalerite from Cu-Pb tailings followed by repeated cleanings yielded a zinc concentrate (53.52% Zn) with a recovery of 82.5%.

Separation of shale from pyrite during mining operations at Amjhore (Bihar) was achieved employing the heavy media separation method; a flowsheet was recommended to the sponsor, Pyrites, Phosphates & Chemicals Ltd, as also details of equipment for setting up a plant for treating 1600 tonnes of the run-of-mine ore per day to obtain 450 tonnes of the concentrate.

A sample of zircon sand concentrate, received from the Hindustan Sanitary Ware & Industries Ltd for upgrading to the grade suitable for manufacturing superior glaze, was subjected to close sizing and high tension separation, which resulted in a clean zircon product containing 0.15% Fe, 0.39% Al_2O_3 and 0.01% soluble iron with traces of TiO_2 and rare earth oxides.

Smelting studies were undertaken at the instance of the Madhya Pradesh Audyogik Vikas Nigam Ltd on the production of standard grades of high-carbon ferro-manganese using low temperature carbonization coke of Katkona Collieries (Madhya Pradesh) with a view to limiting the phosphorus content to less than 0.15% in the ferro-manganese.

Based on laboratory scale investigations on the production of ferro-silico-zirconium by aluminothermic process, large scale production was undertaken at the instance of the Alloy Steel Project, Durgapur for producing ferro-silico-zirconium containing 27-28% Zr, 16-18% Si and 4-6% Al, and a tonne of it was supplied to the sponsor. Work was taken up on the production of 100 kg of aluminium-10% titanium hardener alloy for a defence establishment. The recovery of nickel and cobalt from the ore of Surabil-Sukkarangi-Kumardah sector (Orissa) is being investigated. Reduction of the ore (1.36% NiO and 0·067% Co) at 600°C for 2 hr followed by preconditioning and ammoniacal leaching at NTP resulted in 88% nickel recovery.

As anode slime of electrolytic copper refinery is an important source of selenium and tellurium, studies on the recovery of selenium and tellurium from the slimes of copper refinery of the Indian Copper Corporation have been taken up.

Stainless steel heats of Cr : Mn : N at levels of 17% Cr, 10% and 12% Mn,0.4% and 0.3% nitrogen and 3% copper were made and hot-worked into slabs. Four 10-kg heats were cast into moulds having different cooling rates. Investigations are under way for developing structural steels with improved mechanical properties, adequate workability, optimum corrosion resistance and favourable welding characteristics. Mild steels could be strengthened by adding alloying elements. For grain refinement of steels methods involving the addition of grain growth restraining elements like Al, Ti, V and Nb, and short austenitizing treatment cycles were taken up. A class of heating elements comprising Fe, Cr and Al, which could be employed up to 1150°C, has been developed. A prototype stress-corrosion testing machine was designed and fabricated for stress-corrosion studies on the alloys.

A creep testing laboratory (150 test points) is being set up with the assistance of UNDP Special Fund to meet the increasing demand of the industries for high temperature metals and alloys as well as creep data for the design and fabrication of high temperature materials.

A radioisotope laboratory has been set up with a view to producing and employing the radioactive isotopes as tools in metallurgical research.

Physical properties of the Digboi and Gauhati petroleum cokes and their calcination characteristics were examined with a view to developing a substitute for petroleum coke.

With a view to utilizing clays from Jammu for the manufacture of refractories, large batches of bauxitic clay BC_4 and BC_5 were crushed and briquetted to produce grog at 1500°C. Bricks were formed under a total load of 11 000 lb/in^2 pressure and fired at 1500°C.

A process for the production of high purity electrolytic iron powder with an average grain size of 150-350 mesh having a carbon content of the order of 0.03-0.05% has been developed.

Fifty-three papers were published. A patent relating to an improved method for the removal of vanadium from vanadium pig iron was filed. Four patents in respect of the following processes/products were accepted : (1) production of aluminium alloy anodes for cathodic protection; (2) stabilization of ferro-silicon; (3) manufacture of ferrite magnets; and (4) welding flux compositions.

PROCESSES & PRODUCTS READY FOR COMMERCIAL UTILIZATION

Submerged Arc Welding Fluxes

Welding fluxes are suitable especially for welding light to heavy structural steels and high pressure vessels by submerged arc welding fluxes.

Several types of welding fluxes are known to be produced in the country. However, production falls short of demand, and a large quantity of fluxes is being imported.

The National Metallurgical Laboratory, Jamshedpur has developed improved types of fluxes containing high manganese dioxide. The welding fluxes are substantially noncrystalline and amorphous products. Several welding flux compositions suitable for submerged arc welding, especially heavy structural and pressure vessels, have been developed.

The ingredients required for the manufacture of fluxes include : manganese ore, fluorspar, dolomite, limestone, magnesite, bauxite, chrome oxide, china clay, alumina, sodium aluminium fluoride, chromite, molybdenite, sphene, rutile, silica, sand, quartz, quartzite, iron ore, felspar, serpentine, granulated blast furnace slag, coke and zircon.

The process has been studied on a laboratory scale, and the product has been found to give excellent performance.

Jaw crusher, roll mill, pulverizer, melting furnace, quenching tank and drier are the main items of plant and machinery required in the process. All are available indigenously.

The minimum capacity of an economic industrial unit for the production of welding fluxes suitable for submerged arc welding suggested is 300 tonnes/annum. The estimated capital outlay for setting up a plant is about Rs 3.59 lakhs comprising (i) fixed capital on building of about Rs 87 000; (ii) fixed capital on plant of about Rs 2 00 000; and (iii) working capital (for 3 months) of about Rs 72 000. The cost of production has been estimated at about Rs 1600/tonne of product.

Further particulars may be had from : Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

Polyurethane Coatings

Polyurethane coatings are used for leather, rubber, wood, glass and metal substrates, and nylon fabrics. Although data on the present consumption of polyurethane coatings in India are not available, rough estimates indicate that about 10 000 litres of the product are required for coating leather, rubber, wood, etc. and about 15 tonnes for coating nylon fabrics. Nylon coated fabrics are needed mostly by the Defence for fabricating high-altitude collapsible tents and for making duel shade cloth. Presently the entire demand is met by import.

Process

A process for the manufacture of shellac-polyester-urethane compositions for use in textiles waterproofing, adhesives, paints and varnishes and in electrical insulating varnishes has been developed by the National Chemical Laboratory (NCL), Poona.

Shellac is an indigenous raw material produced in large quantities. Owing to the development of synthetic polymers, its utility and application in the polymer industry have declined. A salient feature of the process developed by NCL is the use of lac or shellac for the manufacture of polyurethane compositions. This would result not only in the proper utilization of shellac but would also make the cheap material available in the country for utilization in the industries mentioned earlier. The process for coating textiles of natural or synthetic fabrics or their combinations, developed by NCL, involves the reaction of hydrolysed lac resin with glycols, dicarboxylic acids and/or amino alcohols to obtain high molecular weight polyesters. For nylon fabrics, a coating solution of desired quality and properties is prepared using a polyester resin. The coating has been tested by the user factories for application as high gloss coating for insole chappals and footballs and has been found to be excellent. In the case of coatings for nylon fabrics, laboratory trials made by local factories have indicated satisfactory performance. The product has been found suitable for use by Defence.

The optimum plant capacities suggested are 10 000 litres per annum of the product for leather, rubber, wood and metal, etc. and 15 tonnes per annum of coating for nylon fabrics.

Castor oil, shellac, toluene, xylene, ethyl acetate, toluene diisocyanate and adipic acid are the main raw materials for the manufacture of coatings. Toluene diisocyanate and adipic acid are not available indigenously and will have to be imported. Other raw materials are available in the country.

Glass flasks, heating mantles, stirrers, thermometers, condensers, plastic tubs and buckets are the main items of plant and equipment. All are indigenously available.

For putting up a plant of optimum capacity for the manufacture of coating for leather, rubber, woods and metal, etc. a fixed capital of Rs 25 000 and a working capital of Rs 38 000 are required. The plant for the manufacture of coating for nylon would require a fixed capital of Rs 80 000 and a working capital of Rs 53 000. The ex-factory unpacked cost of the product comes to Rs 9.40/litre for coatings for leather, rubber, wood, metal, etc. and Rs 9.50/kg for nylon fabrics.

Further particulars may be had from : Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

PATENTS ACCEPTED

Indian Pat. 124509

Production of oxalic acid from sawdust

S.B. Chaudhuri, M. Chakraborty & M.S. Iyengar
RRL, Jorhat

Oxalic acid is extensively used in textile and pharmaceutical industries. The acid is generally manufactured from carbohydrates and cellulosic materials by oxidation with nitric acid. However, manufacture of oxalic acid from cellulosic materials such as sawdust at a competitive cost by nitric acid oxidation process poses a problem in view of the difficulty in the economic recovery of nitric acid for reuse, especially when acid of higher concentrations is used. Also, charring of sawdust during the initial exothermic reaction may take place.

The process covered by the patent relates to the production of oxalic acid from sawdust which is abundantly available from saw mills at a cheap rate. Sawdust is pretreated with water and oxidized with nitric acid (17%) in the presence of a catalyst at 70°C for 3 hr when oxalic acid (yield, 40% of raw material) is obtained. The oxides of nitrogen are absorbed in dilute mother liquor from previous runs. When the mother liquor attains requisite concentration it is reused. The advantages of the process are : (1) Pretreatment of sawdust with water gives uniform yield of product of standard quality. (2) Pretreatment eliminates fire hazards and undesirable side reactions. (3) Costly raw materials such as sugar and other carbohydrates can be replaced. (4) The process is economical since the absorption of oxides of nitrogen into dilute mother liquor and concentration of the liquor to the desired level for reuse are accomplished without difficulty. (5) The plant and machinery required in the process can be indigenously fabricated.

Indian Pat. 126770

Process for recovery of silver and gelatin from waste, processed and/or unexposed photographic films, plates, papers, cine films and X-ray films or plates

S.P. Srivastava, (Mrs) S. Laxmi, P.V. Krishna & M.S. Iyengar
RRL, Jorhat

With the rapid development of the photo-film industry, large quantities of old and discarded processed film materials are becoming available. At present such materials containing gelatin, silver and base film (generally a cellulose derivative) hardly find a profitable outlet. In the original unexposed films the photosensitive silver halides suspended in gelatin are coated on the surface which on exposur us to light and final reduction with the developer are converted to metallic silver. During the usual processing, the unexposed portion of the silver halide is washed away by sodium thiosulphate solution. Thus a processed film surface contains metallic silver (black portion) and gelatin. So far, no efforts have been made for the recovery of silver, gelatin and the cellulosic base material from the waste photographic films.

The process covered by the patent deals with a method for the recovery of silver, gelatin and cellulosic base material from the waste photo-films. The process can also be used for processing film cuttings obtained during the manufacture of fresh, unexposed photosensitive films.

The process involves the use of simple physico-chemical methods for the initial release of silver and gelatin from the films and subsequent stepwise precipitation of silver and gelatin by means of an appropriate dose of a trivalent electrolyte.

Films are soaked with water for about 30 min to wet the surface thoroughly and are heated in a suitable medium for a certain period, whereby the silver and gelatin are released from the base films. Silver is then selectively precipitated from silver-gelatin sol using an appropriate dose of an electrolyte. The silver precipitated is filtered and the filtrate collected for the recovery of gelatin. Gelatin is precipitated by further addition of the electrolyte. Silver and gelatin are purified by the usual methods. The electrolyte can be reused after crystallization.

Indian Pat. 123646

A system for determining very small weights

N. Ramanathan & S. Ananthanarayanan
CLRI, Madras

The invention relates to the development of an instrument (microbalance) for weighing single fibres. The instrument consists of a milliammeter, a microammeter, variable resistances, shunts for the microammeter, a 1.5 V dry cell and an optical magnifying device such as that of a travelling microscope and utilizes the principle of [illegible]nter-balancing a gravitational force by the force created by a magnetic field.

Operation

The optical device is focussed on the tip of the pointer of the microammeter so that it coincides with the horizontal cross-wire of the optical device. The material to be weighed is kept on the spade of the pointer or in an extremely light-weight pan attached to the tip of the pointer. If fibres are to be weighed, they may be suspended from the tip of the pointer by bending them into a V-shape. The pointer moves down and the resistance of the circuit is adjusted to bring back the pointer to its original position as seen through the optical device. The current indicated on the milliammeter is noted and the weight is read from a calibration line drawn with known weights and corresponding currents in the milliammeter. By adjusting the shunt for the microammeter it is possible to use different weight ranges from tens of micrograms to a few milligrams. By changing the two meters, heavier materials can be weighed. The instrument is useful for determining extremely small weights such as of single fibres and hence in microchemical analysis.

The microbalance will be of considerable use in industry and research institutions.

Balances of this type are not commercially available. The device nearest to this microbalance is the torsion balance which is purely mechanical and requires to be imported. In the torsion balance, the sensitivity is fixed whereas in this device, the weight range and the sensitivity can be varied. Further, it is very easy to construct this device whereas torsion balances require special skill and entail the import of fine quartz torsion wires.

The microbalance fabricated is entirely indigenous and can substitute imported balances.

Indian Pat. 126064

Improvements in or relating to wire helix winding for electronic devices such as travelling wave tubes

J. Singh
CEERI, Pilani

Two devices have been designed and fabricated for winding thin tungsten wire helices for travelling wave tube of any length and of diameter varying from 1.5 mm to 20 mm. The devices can be easily fabricated in a precision workshop at a cost of about Rs 50 each. These are more precise than the hitherto known helix winding machines. The advantage of the new devices is that there is no need for highly skilled operator for winding the helices. The helix winding machines available abroad cost Rs 10 000 to Rs 15 000 and require highly skilled operators.

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Vigyan Pragati: Health Hazards Special Number

A special number of *Vigyan Pragati* on Health Hazards has been brought out by the Indian Languages Unit of CSIR. This 160-page issue (December 1971) contains 37 articles covering various aspects of health hazards such as air pollution, water pollution, noise pollution, soil pollution, drug addiction, smoking, occupational diseases, zoonosis, consanguineous marriages and population explosion. Four articles highlight the activities and the work done in CSIR laboratories in the field of public health.

Seminar on Estuarine Pollution

A seminar on Estuarine Pollution is being held in Calcutta on 9 and 10 March 1972 under the joint auspices of the Central Public Health Engineering Research Institute (CPHERI), Nagpur and the Calcutta Metropolitan Development Authority. A large number of public health engineers, scientists, technologists, sociologists and administrators from various government departments, research institutions and universities are expected to attend the seminar.

Those desirous of participating in the seminar may obtain further details from: Dr A. K. Basu, CPHERI Zonal Laboratory, 23 R. N. Mukherjee Road, Calcutta 1.

NEW PERIODICALS

Two new periodicals, viz. Indian Journal of Radio and Space Physics and Indian Journal of Marine Sciences, are being added, from this year, to the family of research periodicals being brought out by the Publications & Information Directorate of the Council of Scientific & Industrial Research in collaboration with the Indian National Science Academy.

Indian Journal of Radio and Space Physics

To be issued quarterly, this periodical is intended to serve as a medium for the publication of research communications (full papers and short communications) in various areas of radio and space science :

Radio frequency standards and measurements
Propagation through non-ionized media
Ionospheric propagation
Magnetosphere
Radio and radar astronomy
Physics and chemistry of the ionosphere
Neutral atmosphere
Airglow
Winds and motion in the upper atmosphere
Stratosphere-mesosphere coupling
Ionosphere-magnetosphere coupling
Solar-terrestrial relationship

Annual subscription* : Rs 30.00 £ 3.50 $ 10.00

Indian Journal of Marine Sciences

This bi-annual periodical will be devoted to research communications (full papers and short communications) pertaining to various facets of marine science research :

Biological oceanography
Physical oceanography
Geological oceanography
Chemical oceanography

Annual subscription* : Rs 15.00 £ 1.75 $ 5.00

*Personal subscriptions are available at reduced rates.

Subscription orders should be addressed to :

Publications & Information Directorate, Hillside Road, New Delhi 12.

PROTEACEAE

The sixth in the series of botanical monographs published by the Publications & Information Directorate, New Delhi, Proteaceae is one of the most interesting but little known families of angiosperms the discontinuous distribution of which poses a phytogeographic problem. Most of the earlier studies on this family were confined to herbarium materials. The author (C. Venkata Rao, Department of Botany, Andhra University Postgraduate Centre, Guntur) has made extensive studies on the morphology, cytology and taxonomy of the group at the University of Tasmania, Hobart, where he worked as a Colombo Plan research fellow.

The monograph contains seven chapters dealing with: distribution; morphology; anatomy; embryology; development of embryo; cytology; and fossil history and phylogeny. As a result of his detailed studies, the author concludes that the nectary is only an enation and therefore the flower is primitively monochlamydeous.

Evolutionary changes in structure and position of ovule, endosperm and endosperm haustoria have been explained.

Though living genera of this family are found concentrated in the southern hemisphere, previous investigators had postulated a northern origin for the family. On the basis of evidence from his studies, the author fixes eastern Australia on a once-connected land mass (Gondwanaland) as the centre of origin of the family. The disjunct distribution of the living taxa is attributed to the continental drift. The antarctic continent probably served as a dispersal route in the past when it was much warmer.

The 208-page (royal 8vo) publication is profusely illustrated (9 halftones and 75 line drawings), and contains a bibliography and an index.

To quote Prof. H. Newton Barber of the University of Tasmania: "The monograph will prove a most useful summary of present knowledge of the group and will certainly stimulate interest in the difficult problem of the evolution of the floras of the southern hemisphere".

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CSIR NEWS

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Centre of Materials Technology and Science : NAL

Advances made in aerospace vehicles elsewhere in the world have given rise to the development of improved and new materials and novel techniques of fabrication. The lack of such materials and techniques in India has become a great drawback for building truly indigenous aircraft and aeroengines. The Materials Science Division of the National Aeronautical Laboratory (NAL), Bangalore, since its inception in 1966, has made considerable progress in the development of materials and material processes for both metallic and non-metallic materials required in aerospace industry.

The creation of a Materials Technology and Science Centre with the Materials Science Division of NAL as nucleus was recommended by the executive council at its meeting held on 22 March 1971. The Governing Body of CSIR at its meeting held on 9 August 1971 considered this recommendation and approved the creation of Materials Technology and Science Centre, which would be an integral part of NAL.

The ultimate function of such a centre is to specialize in the science of materials leading to new tailor-made materials and novel processes and products. This involves considerable basic research. As these activities are of importance to industry and require concerted efforts, the centre would : (1) lay a strong foundation both in developmental activity and research ; (2) interact effectively with industries interested in specialized materials, material processing and testing ; and (3) actively collaborate with scientists and technologists from universities, research institutions and industries.

Initially, the main tasks of this centre would be : (1) fabrication and processing of materials by unconventional methods ; (2) development of composite materials with high strength-to-weight ratio ; (3) development of high temperature materials, particularly titanium and chromium alloys ; (4) development of specialized materials for avionics ; (5) study of properties of materials under extreme environmental conditions ; and (6) undertaking of testing procedures consisting of fractography and failure analysis, and development of advanced testing and characterization procedures.

The activities of the division at present include : development of composite materials, high temperature alloys, light alloys and sophisticated techniques for fabrication and material testing, and high pressure studies and fundamental studies.

The division's achievements in these areas are briefly dealt with in the following paragraphs.

Composite materials

For choosing materials in aerospace industry, strength-to-weight ratio is the most important criterion. Composite materials at once offer an engineer tailor-made materials to suit his specific requirement, and are therefore the materials of the future. An important achievement of the division in this area is the design and construction of small and large filament winding machines for making a variety of components for aerospace, electrical, electronics and chemical industries. Considerable competence has been acquired in pressure moulding techniques. Some of the fibreglass reinforced plastics (FRP) components designed and made at the specific request from industry and other organizations are : nose cones for weather rockets, high voltage insulators for circuit breakers, antennas, antenna masts, accurate parabolic radar dishes for communication system, 6-m diam radomes (transparent to radio waves and capable of withstanding winds up to 300 kmph) and piston rings for naval applications. The feasibility of fabricating metallic composites and other fibre composites is under investigation.

High temperature materials

The components of an aeroengine are exposed to high temperatures, corrosive environment and high stresses, and require high strength oxidation-resistant alloys with optimum creep and fracture characteristics. Nickel based alloys, which are used fairly extensively in other countries, are scarce in India. Chromium ores are available in abundance in the country, and chromium based alloys can be used in jet engines at temperatures higher than those possible with nickel based alloys. A small plant for producing nitrogen-free chromium by electrolysis of chromic acid has been set up for experimental investigations on chromium based alloys. Titanium, because of its high strength and temperature capabilities, is used in fabricating many aircraft components ; and titanium ores are available in abundance in India. The division has, therefore, undertaken investigations on titanium and its alloys. A powder metallurgy technique for forming pure titanium rods has been developed. Studies have also been undertaken on the physical and mechanical properties of titanium and its alloys.

Fabrication and processing of materials

Availability alone of materials is not sufficient for their successful utilization. The special properties which make some of the materials attractive for use in aeronautical industry often render them difficult to fabricate. Unconventional machining techniques are required to be developed. These techniques enable stress-free burrless shaping of complex contours in any metal regardless of hardness or other physical properties. In collaboration with other divisions, the Materials Science Division has developed spark erosion machines of varying capabilities. The pulse generator developed for this machine is of a highly sophisticated type, and keeps the tool wear to a minimum, thus enabling a high degree of precision in the job. A machine for use in steel industry for cutting grooves on steel rolls has also been developed and fabricated. It is proposed to fabricate a few machines on a pilot plant scale. Investigations on the design and construction of electrochemical milling machine, and on photofabrication techniques are under way.

Fractography and failure analysis

Sophisticated testing facilities such as 4.5 Å resolution and 3 million magnification electron microscope and optical metallographs are available in the division. The failure of welded aircraft components, landing gears and nimonic aeroengine blades was studied and the causes were identified. The division is acquiring expertise in modern fractographic techniques and capability in investigating accidents due to material failure.

Advance testing procedures

Testing procedures comprise chemical testing of materials and non-destructive testing. The division is acquiring capability to analyse materials for constituents from ppm level to bulk percentages. The facilities already set up include laser beam spectrophotometer, polarographs, electroanalytical equipment, etc. A sensitive method for the estimation of nitrogen in chromium down to 0.1 ppm has been standardized. Facilities for non-destructive testing by X-ray diffraction techniques have been set up. Using X-ray diffraction techniques, it has been possible to analyse stress corrosion cracks in aircraft components and advise the industry on remedial measures. Studies on structural transformation at high pressure are undertaken using Bond-Mcwhan and diamond anvil camera.

High pressure facilities

High pressure research has tremendous potentialities for application in technology. Under the influence of high pressure many unusual phenomena occur in materials, which are of great interest to solid state physics and solid state chemistry. High pressure induces phase transformation in solids and polymorphism in crystalline solids. Many semiconductors, such as germanium and silicon, undergo pressure-induced polymorphism and exhibit metallic conductivity. The division has established facilities for high pressure research for the first time in India. A 1000-tonne generator, which can produce pressures of the order of 50 000 to 70 000 atm in small volumes, has been constructed. The value of imported components of this equipment is about Rs 40 000, while an entirely imported generator costs about Rs 4 lakhs.

Current programmes in material science are concerned with metal-insulator transition, itinerant antiferromagnetism in chromium and chromium systems, electrical transport in semiconductors and metallic systems and phase transition in solids.

CURRENT RESEARCH PROGRAMMES: NPL

The research projects of the National Physical Laboratory (NPL), New Delhi are divided into four major groups, viz. (1) Maintenance of physical standards; (2) Developmental testing; (3) Applied and developmental research; and (4) Oriented basic research and Radio science.

Standards

The laboratory has a statutory obligation of maintaining primary standards, such as of length, mass, time, current, illumination and temperature and derived standards of electrical resistance, emf, radio frequency, microwave power, force, atmospheric pressure, sound pressure, etc. The laboratory continually tries to improve the accuracy of standards to meet the future requirements of the industry. Reference standards are supplied to users, and as a result the standards laboratory is able to transmit the competence of measurement at the highest level.

The list of standards being maintained by NPL is given in Table 1.

Developmental testing

In pursuance of one of its objectives, viz. to undertake developmental testing, the following types of testing work is undertaken by the laboratory: (1) Calibration and

Table 1—Standards being maintained by NPL, New Delhi

Parameter	*Standard*	*Accuracy*
	PRIMARY STANDARDS	
Length	Metre	5 in 10^8
Mass	Kilogram	1 in 10^7
Time	Second	1 in 10^8
	Frequency	1 in 10^8
Current	Ampere	1 in 10^5
Illumination	Candela	2 in 10^3
Temperature	°K	Av. 0.002 in range 90-700°K
	DERIVED STANDARDS	
Resistance	Ohm (dc)	1 in 10^6
emf	Volt (dc)	1 in 10^6
	Volt (rf)	2 in 10^2
Power	Watt (dc)	1 in 10^5
	rf	2 in 10^2
Force	Newton	4 in 10^5
Atm. pressure	mmHg	1 in 10^3
	Newton bar	
Sound pressure	Microbar	1 db
	dynes/cm^2	

performance testing of equipment, instruments, prototypes, etc.; (2) life and environmental testing of electronic and electrical components and equipment; and (3) testing for the purity and perfection of materials using sophisticated techniques like X-ray diffractography, electron microscopy, Mössbauer spectroscopy, EPR, mass spectroscopy, etc.

Applied and Developmental Research

Metrological and diffraction gratings

An important project undertaken by the laboratory is concerned with the development of metrological and diffraction gratings (Moire grids).

Large size gratings of low line density find an important application in strain analysis and are extensively used by universities and research laboratories. Grating strips of low line density also find application in machine tool control. Diffraction gratings are used for spectroscopic work.

Thin film devices

Thin films of metals, dielectrics and semiconductors find application in various branches of physics such as optics, electronics, infrared remote sensing, etc. They have potential application in industry, specially for the fabrication of optical and electronic devices. In the field of optics, thin film devices, such as interference filters, beam splitters, neutral density filters, anti-reflection coatings, cold mirrors, etc., are in common use. The application of thin films in electronics has opened a new field, viz. microelectronics. Both the active and passive components can be fabricated using thin films. These devices are superior to conventional devices as they are more reliable, cheaper and occupy lesser space. Work will be taken up on the development of sophisticated optical and electronic devices such as cold mirrors, memory cores.

Silicon and semiconductor devices

The project was undertaken to develop know-how for the production of semiconductor grade silicon to meet the requirements of the industry producing silicon transistor, diodes, S.C.R., I.C., etc. With the development of the electronic industry in the country, these silicon devices will be produced in large quantities and according to the estimates of the Electronics Committee about 500 kg of single crystals of silicon will be required for the semiconductor industry in the country in 1973. At present the entire silicon requirements for the semiconductor industry are being imported. The main objective of this project is the substitution of imported silicon by indigenous sources. In addition to single crystal silicon, some simple devices particularly those for which there is a large demand in the country will be developed. These devices include power diodes, S.C.R., etc.

Phosphors

Sulphide based phosphors are being used in large quantities in cathode ray (CR) tubes, TV tubes, X-ray screens, etc. The laboratory's current projects are concerned with the development of phosphors for CR and TV tubes. The requirement of the phosphors is at present met from imports.

Phosphors used in radar screens are also sulphide based. The development of these phosphors will therefore be of strategic importance.

Microwave components

Microwave components are used in radar systems, microwave communication links, satellite communication, navigation and scientific research. The use of these systems is increasing day by day in India. Keeping in view the objective of self-sufficiency and saving of foreign exchange, work was started at NPL on the design, development and batch-production of microwave components required for various microwave frequency bands in the above mentioned systems.

Low pressure air liquefier and cryogenic systems

Low temperature facility has become an essential part of every research establishment. The equipment required to create this facility is sophisticated and is not manufacturerd in India at present, except for a limited number of liquid air containers. The main item of equipment is gas liquefiers and these are imported. Hence the development of low pressure air liquefier was taken up. A machine has been fabricated using low pressure compressors available in the country. Modifications are being effected to improve its cooling efficiency. It is proposed to develop gas refrigerating machines and storage vessels. Apart from meeting the internal requirements of the country the liquefier has good export potential.

Electronic components

According to the Electronics Committee report the targets for electronic components in 1975 are estimated in terms of value at Rs 85 crores. Keeping in view the requirements of the country, work is in progress for the development of ferrites (such as Mn-Zn, Mn, Mn-Mg-Zn), piezoelectric ceramics, etc. These are extensively used in entertainment electronics, telecommunication, etc.

Carbon products

Deveolpment of various carbon products using indigenous raw materials is the main objective of the project. Following the development of projector and process carbons, carbon slabs and rods, work is in progress on the development of electrographitized brush blocks for various applications in industry. Carbon granules used in telephone receivers, which are presently imported, are being developed.

Photocopying machine

The machine is used for document copying and is an essential requirement of libraries, commercial concerns and offices for rapid and accurate dissemination of scientific, technical, commercial and educational information in the form of letters, reports, abstracts, specifications, estimates, catalogues and bulletins. In view of the utility, low cost (about Rs 15 000 while a similar imported machine costs over a lakh of rupees) and indigenous nature of the equipment there is expected to be considerable demand for the machine from university departments and other research institutions. In continuation of the development of a manually operated machine and the release of know-how to industry, an automatic version of the equipment is being developed.

Sonic blind aid

This is an effective and convenient device to aid the blind in finding their way and location of objects. The device gives information about the position of obstacles, their dimensions and also about their surface conditions. The aid can be used in foggy and humid weather conditions under which other optical and some electromagnetic devices are not effective.

Cathode-ray and TV picture tubes

Cathode-ray oscilloscope is one of the most vital instruments used in almost all electronic applications. Many industries in India are now making CR oscilloscopes but cathode-ray tubes used in these instruments are imported. Television picture tubes are also another class of cathode-ray tubes. After the successful development of the technology for CRT, work was undertaken to develop 9-, 12-, and 16-in. size TV picture tubes and also techniques of reconditioning old TV picture tubes.

Electronic adding machine

Calculators in use in the country, either mechanical or electromechanical type, are presently imported. The aim of developing an electronic desk calculator is to offer a better type of calculator which supercedes the mechanical or electromechanical types in its speed, data handling capability and ease of operation. The project has been sponsored by a firm.

Gas lasers and laser systems

The use of the laser has resulted in the improvement of precision by at least one order of magnitude in the measurements of length, phase change (optical testing), velocity, angular rotation, strain and deformation of solids and in alignment and other optical tooling. Standardization and precision measurement of these quantities being a primary function of NPL, work on the development of this new teachnique has been taken up by the laboratory.

Gas lasers are most suitable for application in precision measurements, but have a limited life both in storage and usage. Therefore, it is essential to have a reliable indigenous source of supply of these lasers. The first phase of the project is, therefore, directed towards the development of reliable single mode He-Ne lasers required in metrology. After acquiring the complete know-how of making such lasers it will be made available to industry for commercial utilization.

Oriented basic research

Work on basic research problems undertaken by the laboratory is concerned with : Mössbauer studies in rare earth cobaltates and ferroelectric materials; transport properties of dilute magnetic alloys; X-ray absorption studies; magnetic susceptibility measurements; Josephson radiation and electron microscopic studies of amorphous semiconductors.

Radio science

The research programmes in the field of radio science are concerned with: (i) radio frequency standards and radio propagation services; (ii) application programmes; and (iii) exploratory work.

The results of these studies are utilized by communication and navigation systems and government agencies. In the coming years India would be spending several hundred crores of rupees for the development of communication and navigation systems and services. Investigations being carried out at NPL on radio propagation problems would be of immense value in the above programmes. Research projects in progress are : propagation data services; aeronomy, ionosphere physics and solar terrestrial relationships; lf and vlf propagation studies; riometers; and high latitude rocket studies.

Get-Together on Processes Developed by RRL, Jorhat

A get-together on the Processes Developed by the Regional Research Laboratory (RRL), Jorhat was held on 29 and 30 November 1971 at the laboratory. The main purpose of the get-together was to bring to the knowledge of prospective entrepreneurs and equipment manufactures the processes and products developed by the laboratory and to solve their technical queries in regard to these processes. The get-together was attended by over 100 delegates from all over the country. A feature of the get-together was the participation of some industrialists who brought home to the laboratory their experiences in utilizing the laboratory process.

The get-together was organized as group discussion in five technical sessions devoted to: (1) Agro-based industries; (2) Organic chemicals and pharmaceutical intermediates; (3) Inorganic chemicals and mineral based industries; (4) Cellulose and paper products; and (5) Miscellaneous industrial processes. A brief resume of the papers included in each of the sessions was given by Dr M. S. Iyengar, the Director, at the outset, and detailed technical queries on the processes were answered by the project leaders and other scientists working on the projects.

The session on agro-based industries included nine papers dealing with: cultivation of citronella grass and extraction of oil; cultivation of *Solanum* species and recovery of solasodine; cultivation of Japanese mint: binderless process for the production of particle boards; extraction of caffeine from tea waste and coffee beans; production of oxalic acid from saw dust, of tartaric acid from tamarind leaves; building bricks based on paddy husk; and household detergents based on paddy husk.

The tea industry in Assam has taken advantage of the laboratory's work on essential oil. More than 2000 acres of land have been covered by citronella grass and substantial quantities of oil are being supplied to consumers in Bombay. The need for utilizing tea waste by the tea industry for the production of caffeine was stressed and it was pointed out that for every 3000 tonnes of tea produced in the country, about 1000 tonnes of prunings are obtained, and these contain 2-4% of caffeine and could be used as a source of caffeine. Shri S. Kamath, who is producing caffeine by the RRL process, said that the process was a complete success and that the efficiency of caffeine extraction was as high as 96% in certain batches. Caffeine worth Rs 3 lakhs had already been produced and sold by Assam Pharma Co. to consumers all over the country.

Shri S. K. Dutta (Director, Toklai Experimental Station, Jorhat), chairman of the session, drew attention to the possible yields of tea if prunings are not used for mulching. He also considered the possibility of using tea prunings after extraction for mulching purposes and said that the economics of the proposition had to be looked into.

At the session dealing with organic chemicals and pharmaceutical intermediates the laboratory's work reviewed included: processes for 8-chlorotheophylline and theophylline starting from caffeine; process for triphenyl phosphate; possibilities of utilizing chlorobenzene for the production of a large number of drugs and chemical intermediates such as phenacetine, *p*-acetamol, *p*-anisidine and 8-hydroxyquinoline; manufacture of cinnamon leaf oil from *Cinnamomum tamala* leaves; manufacture of tolbutamide, an important antidiabetic drug, from *p*-toluenesulphonamide (a waste product of saccharin industry); and process for the manufacture of strawberry aldehyde, a perfumery intermediate.

The chairman of the session, Shri P. V. N. Raju (Works Director, Biological Evans, Hyderabad), enquired if a satisfactory process for conversion of 8-hydroxyquinoline to iodo chloro derivative of satisfactory purity could be produced. Dr K. W. Gopinath of the laboratory said that this project could be taken up.

Eleven processes reviewed at the session on inorganic chemicals and mineral based industries relate to: silica gel; aluminium sulphate; oil well cement and oil well cement additive; vertical shaft kiln for cement manufacture; carbon black from Assam coal; activated carbon from Assam coal; sodium hydrosulphide; pulp cement roofing sheets; artificial aggregates for civil engineering construction; and rocovery of zinc and carbon electrodes from used dry cells.

A significant achievement of the laboratory is the development of a novel process for the production of carbon black from Assam coal in 20% yield based on coal processed. The capital investment and production cost of the product are one-third compared to the conventional process. Another important achievement of the laboratory mentioned at this session was the development of a process for pulp cement boards, which eliminates the use of imported asbestos (presently used in asbestos-cement boards). The additive for oil well cement, developed by the laboratory, has been found satisfactory on laboratory trials by Oil India Ltd.

There was considerable discussion on the pre-design cost estimates submitted by the laboratory for various processes, and it was felt by many participants that the estimates were on the high side. It was pointed out by one of the scientists of RRL that these estimates were based on a standard costing procedure suggested by the National Research Development Corporation of India, which may not be true particularly in regard to small scale industries.

With regard to the laboratory's process for the production of pulp-cement boards, the possibility of utilizing other materials like mineral wool, coconut fibre, etc. in place of pulp, which is presently in short supply in the country, was discussed.

Papers presented at the session devoted to cellulose and paper products dealt with: matrix board; de-inking of waste paper for the production of newsprint; low cost paper house; microcrystalline cellulose; parchment paper; grease-proof and glassine paper; laminated products; paper gasket; and paper-twine.

In a reference to the de-inking process developed by the laboratory, the chairman of the session, Dr V. S. K. Nair (Titaghur Paper Mills Co. Ltd), remarked that the process could be used for the preparation of writing paper but to obtain whiteness and other characteristics it should be necessary to use loading material during the de-inking process; it was also suggested that the washing method would be more beneficial than the floatation method for the removal of ink. Dr Iyengar mentioned that the process involved addition of a floating agent to remove ink particles and that by a judicious choice of the wetting agent, it should be possible to remove the loading agent also. The problem had to be examined further.

In the field of paper and paper products, an important achievement of the laboratory is the development of a process for the production of matrix board which is at present entirely imported. The product is cheaper than the imported material, and raw materials and chemicals required are indigenously available. The laboratory has also developed speciality boards and paper boards which are water- and fire-proof and can be used for construction of low cost houses and for the manufacture of plyboards and other low cost boards. The cost of houses varies from Rs 5 to 10 per built-in square foot, depending on the design. A project has been taken up in collaboration with the Tocklai Experimental Station to utilize these boards for manufacturing tea chests for export of tea. The know-how for making paper twine, which is at present imported in considerable quantities, has also been developed by the laboratory.

Work of the laboratory reviewed at the session relating to miscellaneous industrial processes included: production of active dry baker's yeast from molasses; manufacture of paraffin wax from slack wax; paraffin wax from spent fuller's earth; microcrystalline wax from wax scrapings; high speed gear for bicycle; machine for making paper twine from paper tape; water filters; and recovery of silver, gelatin and cellulosic base from photographic films.

A process for the production of paraffin wax from the indigenously available slack wax has been developed. There is acute shortage of paraffin wax in the country and therefore this process is of considerable interest. Another important achievement of the laboratory mentioned at the session was the development of a high-speed gear bicycle. This bicycle has a speed 3 to 4 times the normal speed of a bicycle and could be manufactured by cycle manufactures without much increase in the capital. The process for the manufacture of microcrystalline wax from wax scrapings, which are available in considerable quantity in Gujarat oilfields, is significant as at present microcrystalline wax is entirely imported.

Twenty-third International Conference of Pure and Applied Chemistry

Dr S. L. Kapur of the National Chemical Laboratory, Poona, attended the twenty-third International Congress of Pure and Applied Chemistry held at Boston (USA) from 25 to 30 July 1971, on the invitation of the Macromolecular Chemistry Division of the International Union of Pure and Applied Chemistry. Attended by over 1000 scientists from all over the world, the conference was divided into two major parts—organic symposia and macromolecular symposia which, in turn were divided into several sections. Another set of symposia were held under the title 'joint symposia', which dealt with topics of common interest to both organic and macromolecular chemists.

Organic symposia were divided into 13 groups: Applications of quantum mechanics to organic reaction paths; Short lived intermediates; Spectroscopy in structure determination; New natural products syntheses; Intramolecular rearrangements; Insect chemistry; General methods of syntheses; Organo transition metal chemistry; Photochemistry; Medicinal chemistry; Free radicals and homolytic mechanisms; Small rings; and Biosynthesis. Symposia on macromolecules were divided into 14 groups: Dynamics of conformational changes in macromolecules; Photochemistry of macromolecules; New developments in ionic polymerization; Electrical and optical properties of polymers: New developments in free radical polymerization; Membranes structure and transport; Reactions and modifications of polymers; Heterophase polymer systems; Medical polymers; Polymerization and copolymerization of heterocyclics; Olefin copolymers; Developments in polymer morphology; Interface and adhesion problems in polymer composites; and New monomers and polymers. Joint symposia were divided under the following titles: Homogeneous catalysis; Mechanism of enzyme action; Advances in conformational analysis; Ion pair processes; and Synthesis and conformation of biopolymers. Each group had 6 to 8 invited lectures by leading scientists in the field. A large number of contributed papers in each group were discussed by groups of interested scientists.

In the sections dealing with macromolecules, various aspects of the chemistry and physics of macromolecular science were thoroughly covered by invited lectures and contributed papers. Interesting work was presented in the sections relating to polymerization and copolymerization of heterocyclics and new monomers and polymers. Synthesis of new polymers with exceptional properties was reported, and the use of recently developed reactions as new routes for the syntheses of macromolecules was discussed. The use of ring-opening reactions, cyclo-addition reactions and photochemical reactions for making new polymers was apparent from the discussions.

Interesting discussions were held in the section devoted to new developments in ionic polymerizations in which Dr Kapur was a participant. The work of Dr J. P. Kennedy on the synthesis of graft copolymers using corbonium ion reactions was highly appreciated, as it has opened up a new approach for producing graft copolymers at very fast rates with the virtual absence of ungrafted homopolymers. Graft copolymers are extremely useful for the modification of polymers and also for compatibility of two or more polymers for specific end uses. Dr Kapur discussed the polymerization of polar monomers with Ziegler-Natta catalyst systems. Till recently it was held that polar monomers cannot be polymerized by Ziegler-Natta type catalyst systems. However, Dr Kapur's work has clearly established that polar monomers can be polymerized by coordinated anionic mechanism using Ziegler-Natta type catalysts under suitable conditions, giving stereoblock polymers. The work of Dr J. Boor on the mechanism of Ziegler type catalysts was also greatly appreciated.

In the symposium on medical polymers, Dr Lim of Czechoslovakia presented an interesting paper on the effect of hydrophilic polymers on blood. A detailed discussion was presented on the synthesis and properties of bio-compatible polymers in a series of lectures.

Joint symposia brought out new aspects relating to the mechanisms of organic and macromolecular reactions.

Staffing and Funding Patterns in CSIR

The results of a survey* dealing with the budget and staffing patterns in CSIR laboratories have been published by the Division for Scientific and Technical Personnel of CSIR. The data were obtained through a questionnaire.

The annual budget of CSIR, it has been observed, increased from about Rs 1.5 crores in 1950-51 to Rs 6.3 crores in 1960-61 and to Rs 22.1 crores in 1970-71. Thus, the CSIR budget has increased 3.5 times betbeen 1960-61 and 1970-71, while the total staff has increased 1.8 times. More than 80% of the fund (1970-71) is allocated to national laboratories engaged in R & D work; over 10% is utilized for funding cooperative research associations, grants-in-aid schemes, research fellowships, scientists' pool, etc.; and administrative and other miscellaneous items account for the rest.

The tolal staff strength of the Council covering all categories of employees by the beginning of 1971 was about 16 750. The survey report is concerned with about 6000 scientific and technical personnel who are more intimately connected with the R & D work and other allied researches within CSIR.

The thirty laboratories have been grouped into the following four categories according to the major disciplines to which the individual laboratories are devoted: (i) physico-chemical, (ii) engineering, (iii) bio-medical, and (iv) multipurpose (comprising four regional research laboratories). Fund-wise, it has been estimated that the average annual budget of a physico-chemical type laboratory is about Rs 71 lakhs, followed by engineering type (Rs 52 lakhs), bio-medical type (Rs 30 lakhs) and multipurpose type (Rs 48 lakhs).

The average size, in terms of staff strength, of the laboratories concerned with physico-chemical research is the largest; next in order are engineering, multipurpose and bio-medical groups of laboratories. Taking the bio-medical group as 1, the relative sizes of the other groups are: multipurpose 1.2; engineering 1.5; and physico-chemical 1.9. Of the total research staff of 6184 employed in the 30 laboratories, nearly 87% among the research executives and scientific and technical officers hold high academic qualifications— 33.7% doctorates, 37.6% postgraduates, 14.7% graduates in engineering and 0.5% in medicine. Even at the levels of scientific/technical assistants and laboratory assistants, over 40% hold high qualifications (33% at postgraduate level). Among the R & D staff, about two-thirds are scientists and about one-third are engineers while medical personnel constitute only 2%. While most of the national laboratories are concerned with materials development, the low proportion (2.7%) of geologists and geophysicists is considered inadequate. Ninety per cent of the staff from the level of director to junior scientific assistant are engaged in research; 20% in fundamental, 57% in applied and 13% in the techno-economic aspects of R & D. Bio-medical group of laboratories has been found to lay maximum stress (32.3%) on fundamental research, the physico-chemical group coming next with 21.3%. The physico-chemical group has the highest percentage of staff (about 61%) engaged in applied research. In the engineering laboratories 51% staff are engaged in applied research and 22% in techno-economic research. In the other three types of laboratories there is lesser accent on techno-economic studies and research.

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*Staffing and Funding Patterns in the Council of Scientific & Industrial Research (1970-71): A Study by the Division for Scientific & Technical Personnel, CSIR.

In the senior scientific/technical assistant cadre, there are about 100 PhDs, and about 100 postgraduates in laboratory assistant cadre. About 250 professional graduates (mostly engineers) also are to be found among these categories.

The personnel of the scientific and technical organizations of CSIR other than the thirty national laboratories are engaged in techno-economic research, manpower and industrial survey, collection and analysis of data for science management, writing of reports, monographs, etc., publication of scientific journals and encyclopaedias; scientific documentation and translation, and dissemination of scientific information through popular publications and demonstrations.

The survey also reveals that about 37% of the staff was recruited in CSIR between 1960 and 1965, and 30% between 1965 and 1970; and one out of eight has completed 15 years of service. On the whole, 90% of the scientific and technical staff continue to remain within CSIR. Concerning promotions in CSIR more than 80% of the deputy directors, assistant directors and senior scientific/technical officers (grade I) were found to have reached their present levels from lower positions.

With regard to career advancement, it has been noticed that assistant directors have a relatively high order of stagnation; the same holds good of senior scientific/technical officers (grades I and II). Scientific and technical assistants, most of whom are well qualified, were found to be similarly handicapped.

The survey has also revealed that only about a tenth of the scientific and technical staff are confirmed in their present positions, while another one-third are confirmed in junior grades. Nearly 45% of the staff are temporary and 12% hold contract jobs.

Microphonic Carbon Granules

A process for making microphonic carbon granules used in telephone receivers has been developed by National Physical Laboratory, New Delhi. The process involves thermal dehydrogenation of specially selected coals in controlled gaseous environments and mechanical treatment to bring about the desired shape and size of the granules. The properties and performance of the granules are comparable to those of the imported material.

Microphonic carbon granule is a small but essential component of telephone receivers, and is imported to the extent of 500 kg/annum.

Dielectric Behaviour of Liquid Mixtures at Microwave Frequencies

Investigations on the dielectric behaviour of liquid mixtures at microwave frequencies have been carried out by Shri R. S. Yadav of the National Physical Laboratory, New Delhi, under the guidance of Dr Ram Parshad of the laboratory. The relaxation times and dipole moments of a number of homologous series of polar liquids, both non-associated and associated in pure states, have been determined in dilute solutions of cyclohexane, benzene, carbon tetrachloride and dioxane. Special methods of accurate determination of impedance at microwave frequencies were evolved so that the small variations of relaxation times and dipole moments of the polar molecules in different solvents could be interpreted in terms of intermolecular action taking place in the liquid mixtures.

Relaxation times of molecules of non-associated polar liquids in dilute solution have been observed to be least in cyclohexane and highest in dioxane. The results have been interpreted as due to least solute-solvent interaction in cyclohexane resulting in least potential barriers for molecular rotation. In dioxane, on the other hand, the outlying negative parts of the residual dipoles react with the outlying nagative or positive parts of dipoles of the polar solutes resulting in the enhancement of the potential barriers hindering molecular rotation under the applied electric field.

The dipole moments were observed to be the least in carbon tetrachloride, indicating that due to the chlorine of carbon tetrachloride lying in the neighbourhood of the rotating dipoles the C-Cl dipoles of CCl_4 and the revolving dipoles of the polar liquid form a dynamic combination in series opposition.

In contrast to the above results, molecules of the associated primary aliphatic alcohol series give the highest relaxation times in cyclohexane and lowest in dioxane. This result has been explained as due to the strong solute-solute interaction compared to solute-solvent interaction and the resulting cluster formation of the polar molecules in cyclohexane. In dioxane, the residual dipoles of the solvent lead to strong solute-solvent interaction preventing the cluster formation of the alcohol molecules.

The dipole moments of alcohol molecule are lowest in cyclohexane, confirming molecular cluster formation in the solvent.

It is probably for the first time that a detailed interpretation of the variation of relaxation times and dipole moments in different solvents has been done in terms of molecular interaction taking place in the mixtures.

Mixtures of the polar liquids, chloroform-ether and chloroform-acetone, were investigated with regard to dielectric polarization and absorption. The results indicate strong bimolecular interaction leading to absorption peak in the mixture and to the production of higher complexes than the bimolecular complex, which was not revealed by investigations at rf frequencies.

The dielectric behaviour of liquid oxygen, nitrogen and air has been investigated. The dielectric loss in all the liquids is negligible and the dielectric constant of liquid air was found to be higher than the dielectric constants of the components. This has been interpreted as due to the non-additivity of polarizability taking place in liquid air.

Shri Yadav was awarded the Ph.D. degree of the Agra University, Agra.

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CURRENT RESEARCH PROGRAMMES : SITRA

Seventeen projects in various branches of textile technology and human relations are being studied at the South India Textile Research Association (SITRA), Coimbatore. These include six projects of a fundamental nature dealing with fibre science, five projects in processing technology, which are of immediate benefit to member mills as well as six projects sponsored by government and other agencies like the Textiles Committee, United States Department of Agriculture and Southern India Millowners' Association. One of the important projects undertaken is concerned with 'open end spinning' under a special grant from CSIR.

A brief account of the scope and objectives of important projects is given in the following paragraphs.

Fibre Science

Cotton fibre structure

Microscopic and gravimetric measurements on individual fibres and fibre bundles respectively have shown that there is a tapering off in the cotton fibre from the root to the tip and this is best characterized in the modal length group of the cotton. Further work on birefringence and molecular orientation is expected to throw fresh light on the structure of cotton fibres and also on the influence of cotton fibre taper on the physical properties and the spinning performance of cotton.

Crystallinity, disorder, molecular orientation, spiral angle and crystallite sizes of seven cottons, mostly Egyptian, have been analysed by X-ray diffraction techniques before and after treatment with urea and/or mercerization. The results indicate that the directions of the molecular chain and the crystallite axis may not coincide as assumed hitherto and that the imperfections envisaged in the weak link theory of fibre strength may be closely related to the paracrystalline lattice distortions.

Mechanism of rupture in cotton fibres

The aim of the project is to obtain more fundamental information on the factors contributing to high fibre strength in cotton and to know the kinds of structural modifications that are needed to achieve higher strength. The work is expected to lead to fundamental knowledge with regard to specific fibre properties which differentiate high-strength cotton fibre from normal-strength cottons. The investigation will cover such different aspects as morphological features, birefringence and fine structure characteristics.

Effect of fibre friction on yarn properties and processing performance

This study is aimed at getting a better understanding of the role of fibre friction in relation to mechanical processing and product quality. Cottons and man-made fibres varying significantly in fibre friction as measured on the instrument fabricated at SITRA, other important fibre properties remaining reasonably constant, have been selected for the purpose. Processing of selected fibres and blends will be taken up.

Effect of swelling and shrinkage of fibres on their arrangement in yarn structure

The objective of this investigation is to study the arrangement of fibres in blended yarns before and after mercerization. The direction and extent of fibre migration in yarn cross-section are determined by the relative length, fineness and swelling capacities of the individual components. Indications are that swelling forces occurring during mercerization in a blend are capable of modifying radial and longitudinal arrangement of fibres in yarn structure. The information obtained from this study will be useful in the manufacture of blended yarns with desired yarn characteristics.

Processing Technology

Open end spinning

This is a CSIR sponsored project with a full-term grant of Rs 3.34 lakhs for three years. The project has two objectives: (i) to develop a prototype for the production of spun yarns by unconventional means; and (ii) to compare the properties of unconventional yarns with those of ring-spun yarns. An experimental frame has been constructed and speeds up to 30 000 rpm have been achieved. Experiments have also been started on the production of yarns by air vortex method.

Evaluation of raw material quality

The aim of the scheme is to evolve sampling procedures for evaluating cotton quality on a scientific basis. The first step in the study would be to assess the bale-to-bale and within-bale variations in fibre length, strength, fineness and maturity and trash. Based on the results of the study it is proposed to fix the number of tests, method of drawing samples and permissible deviation of the sample results from the agreed values by means of statistical methods.

Effect of ambient atmospheric conditions on yarn quality and spinning efficiency

An extensive study of the effect of ambient atmospheric conditions during spinning on yarn strength in general and end-breaks in particular is nearing completion. The results indicate that an atmospheric temperature of 20 to 25°C and a relative humidity of 41-48% produce the least number of end-breaks during spinning. Maximum strength under standard conditions of laboratory (27°C and 65% RH) is obtained from the yarns spun at the highest levels of relative humidity and temperature (33°C and 76% RH) and maximum elongation at the lowest levels of temperature and humidity (20°C and 34% RH).

Cotton and cotton blended yarns for high speed warp knitting

High speed warp knitting is a comparatively new concept of production of fabrics quite different from weaving and is emerging as an important branch of textile industry. The aims of this investigation are: (i) to explore the possibility of using cotton yarns and cotton blends in high speed warp knitting, and (ii) to specify the quality requirements of such yarns for satisfactory processing.

Effect of top roller pressure and cot hardness on end-breaks and yarn quality

The objective of the project is to study the effect of top roller pressure and its variations on yarn quality and end-breaks under varying cot hardness and at high spindle speeds. Soft cots in general have been found to produce even yarns. The highest roller pressure tried has yielded yarns with the lowest U% and least end-breaks for both soft and hard cots and at both speeds.

Thick and thin places in yarn

The object of the investigation is to study the effect of raw material, blending, combing, processing parameters and mechanical condition of machines on the number of thick and thin places in yarn. To study the effect of raw material on thick and thin places, it is proposed to examine the fibre properties at thick, thin and normal places of yarns, and correlate the fibre properties with thick and thin places in yarns spun from different cottons.

Use of viscose-cotton yarns in dress fabrics

The possibility of using viscose and polynosic fibres in blends with cotton for specific end uses was investigated earlier by SITRA with a view to minimizing import of the cottons. In the present study the scope has been extended to find the feasibility of using viscose staple fibre in fabrics which generally undergo sophisticated finishes like sanforizing, easy-care finishes, etc.

Stretch fabrics from cotton and cotton blends

The objectives of this study are: (i) to develop certain selected stretch fabrics from cotton and cotton blends; and (ii) to determine the quality and performance of such yarns and fabrics.

Preliminary trials made at SITRA have shown that various degrees of stretch can be imparted to cotton yarns and bicomponent blends of cotton with man-made fibres using slack mercerization. It is proposed to extend this work to the development of one or two types of stretch fabrics which are of commercial interest.

Surveys

A survey of knitting industry, sponsored by the Southern India Millowners' Association, has been undertaken with the following objectives: (1) to find out the yarn quality requirements of the knitting industry; (2) to study the technical, economic, organizational and financial aspects of the knitting industry; and (3) to suggest measures that knitting units, spinning mills and Central and State Governments might undertake in order to help the industry to develop in tune with the developments in other countries. The survey is expected to reveal the present state of the industry from the organizational, technical and financial points of view. This information would enable the taking of major policy decisions with regard to further growth of the industry. It would also enable SITRA to plan the type of research that would be most useful for the knitting industry.

Another project undertaken by SITRA is concerned with the study of the work assignment agreements entered into by mills with the labour. The study will be useful to the mills in reviewing the scope for achieving better results by improving working conditions and for an upward revision of their work assignment.

Other projects receiving the attention of SITRA relate to: (i) motivation research for textiles to assess the reasons for consumer behaviour; and (ii) assessment of consumer preferences to enable manufacturers to cater to the changing patterns in textile purchases.

Role of Science and Technology in India: Second Foundation Day Lecture at RRL, Jorhat

Shri C. Subramaniam, Union Minister for Planning, and Science and Technology and Vice-President, CSIR, delivered the second foundation day lecture on the 'Role of Science and Technology in India' on 14 January 1972 at the Regional Research Laboratory (RRL), Jorhat. He said that the role of science and technology in the national development programmes has now acquired a crucial character. Referring to the mid-term appraisal of the Fourth Five-Year Plan, the Minister said that the overall picture that emerges is, on the one hand, heartening in the field of agriculture, exports and some industries, while on the other, distressing with regard to the unemployment situation. He stressed that the role of the newly constituted National Committee on Science and Technology (NCST) should be viewed against this background. NCST would determine the priorities relavant to our society for stepping up the R & D in which the national laboratories and private sector would play an important role. One of the most important tasks of CSIR laboratories is to update and upgrade the technical performance. A comprehensive survey of the country's natural resources, preparation of a time-bound programme for broader technological developments and better utilization of indigenous scientific talent are some of the new measures, the Vice-President said, which are being initiated to help improve the country's economy.

In his welcome address, Dr M. S. Iyengar, the Director, reviewed the progress made by the laboratory. He said that over 50 processes of proven commercial potential have been developed by RRL, Jorhat; over 25 licences have been issued to entrepreneurs and 30 proposals are under negotiation.

A fuller account of the laboratory's achievements has been published in *CSIR News*, Vol. 22, p. 20.

Hydraulic Sand Stowing

As a result of investigations carried out by the Central Mining Research Station (CMRS), Dhanbad, the efficiency of the hydraulic sand stowing plant in a mine has been increased from 10 m³/hr to 40 m³/hr, bringing down water consumption by more than 1.5 times. In another mine, where sand did not flow through the pipes up to the face and production had totally stopped, a rate of stowing of about 60 m³/hr has been achieved. Further investigations in this mine are in progress for improving the rate and overall efficiency.

Most of the hydraulic sand stowing plants in Indian coalmines operate at low head. Sometimes the rate of sand stowing decreases to a very low value with the increasing horizontal distance of the stowing faces from the mixing chamber and water consumption rate increases abnormally. In such cases the rate of production falls and the cost of pumping increases.

The procedure worked out by CMRS for increasing stowing efficiency is as follows:

Water at a suitably high pressure from a water pump is injected in the stowing range through a specially designed cone at a suitable point away from the mixing cone or trough. Due to the high suction created, sand-water slurry is sucked through the stowing pipe and passes through a mixing pipe at a very high velocity. The kinetic energy of the slurry is converted into potential energy in a specially designed diffuser and subsequently the slurry flows through the stowing range at an appropriate velocity to the discharge point in the goaf.

3-Amino-*p*-cresol

A process for the manufacture of 3-amino-*p*-cresol starting from 3-nitro-*p*-cresol through electrolytic reduction using a rotating cathode has been developed by the Central Electrochemical Research Institute, Karaikudi. The compound is used in the manufacture of various dyes, such as Eosamine B, Coccinine B and Diamino Fast Violet BBN; it also finds use in the manufacture of optical whiteners.

The process (Indian Pat. 110852) has several advantages: yields a product of high purity without iron contamination; has high current efficiency; simplifies product isolation; and facilitates design of high amperage cells. The salt is isolated either as a sulphate or as a free base.

The chemical is presently required to the extent of 30 tonnes/annum and is mostly imported.

New Method for Rapid Estimation of Phosphate

A titrimetric method for rapid and accurate estimation of phosphate in minerals and mineral products, including phosphatic fertilizers, has been developed by the Central Glass & Ceramic Research Institute (CGCRI), Calcutta. The method is also suitable for estimation of phosphate in ceramics and related materials such as opal glass, bone china, bone ash, chlor-apatite, and rock phosphate. It is based on quantitative precipitation of phosphate as zirconyl phosphate ($2\ ZrO_2.P_2O_5$) with a known excess of zirconium solution and back titration of the excess with EDTA in $1N$ nitric acid using xylenol orange as indicator. Most of the other elements commonly present in phosphate-containing minerals, mineral products, fertilizers and ceramic materials do not interfere. Fluorine, if present, is required to be removed by fuming with perchloric acid and boric acid. The method has been found to be very accurate and is applicable to solutions having a wide concentration range of phosphorus pentoxide. The time taken for estimation is less than 90 min, compared to few days required when gravimetric or other titrimetric methods are used. In the case of silicate materials containing high alumina and fluorine, however, the estimation may take 3½ hr.

Composition of Seed Fats and Fish Oils

The composition and structure of glycerides of some seed fats containing normal and hydroxy (ricinoleic and kamlolenic) fatty acids and the composition of five fish oils have been studied by Shri A. Rajiah of the Regional Research Laboratory, Hyderabad, under the supervision of Dr K. T. Achaya.

Glycerides: Oil from seeds of *Thespesia populnea* (family Malvaceae) was found to resemble cottonseed oil in its fatty acid composition. The glyceride structure of *T. populnea* seed oil was determined using Coleman's method of calculation. The glycerides, like the fatty acids, were found to be similar to those in cottonseed oil.

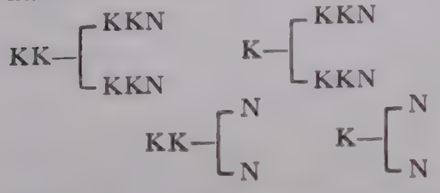
The seed oil from *Hiptage benghalensis* (family Malpighiaceae) was found to be a rich source of ricinoleic acid (85%), next only to castor oil which contains 90% of this acid.

The glyceride structure of the oil and its fractions has been worked out. A study of castor oil triglycerides revealed the presence of 72% triricinolein; di-, mono-, and non-ricinoleins constituted the rest of the material.

A detailed study of the glycerides from the oil of kamala (*Mallotus philippinensis*, family Euphorbiaceae) seeds has shown the presence of different glyceride types having molecular weights ranging from 900 to 2300. As the oil contains 70% of a very highly polymerizable and unstable fatty acid, viz. kamlolenic acid (ω-hydroxy-α-elaeostearic acid), the usual analytical methods are not easily applicable to this oil. Hence, a micro method for glycerol estimation involving gas-liquid chromatographic analysis of silylated glycerol, which uses hexadecane as internal standard, has been developed.

The normal chemical procedure for the determination of ester groups in oils involving colorimetric determination of ferric hydroxamates has been slightly modified and used for the estimation of ester groups in kamala seed oil and its glyceride fractions. The method involves the conversion of the ester into ferric hydroxamate and measurement of the colour at 540 mμ. This procedure has been standardized and used for determining the number of ester groups in a normal oil like groundnut oil. Groundnut oil showed the presence of 3 ester groups per mole and kamala seed oil and its fractions were found to contain 3 to 8 ester groups per mole.

The results of studies on the glyceride of kamala seed oil show that multiester linkages are present in kamala seed oil and that kamlolenic acid preferentially attaches itself to the 2-position of the glycerol molecule. It also supports the contention that the following glyceride types are likely to be present in kamala seed oil :



$$\mathrm{KK}-\left[\begin{array}{l}\mathrm{KKN}\\ \mathrm{KKN}\end{array}\right.\qquad \mathrm{K}-\left[\begin{array}{l}\mathrm{KKN}\\ \mathrm{KKN}\end{array}\right.$$

$$\mathrm{KK}-\left[\begin{array}{l}\mathrm{N}\\ \mathrm{N}\end{array}\right.\qquad \mathrm{K}-\left[\begin{array}{l}\mathrm{N}\\ \mathrm{N}\end{array}\right.$$

where K is kamlolenic acid and N is a normal fatty acid.

Composition of fish oils: The component acid analysis of four freshwater fish (Gowra, Catla, Rohu and Murrel) fats and one boundary fish (black pamfret) fat was carried out.

The presence of large proportions of C_{18} unsaturated acids and reduced proportions of C_{20} and C_{22} unsaturated acids has been indicated in the body fats of freshwater fish. Odd-numbered acids (C_{15} to C_{17}) were found present in almost all the fish fats studied. Palmitic acid was the predominant saturated fatty acid.

Shri Rajiah was awarded the Ph.D. degree (1971) of the Osmania University, Hyderabad for his thesis entitled 'Components of Indian fatty materials'.

Utilization of Indian Fly Ashes: A Technical Appraisal—CRI

About 4 million tonnes of fly ash are being produced annually in India by 30 thermal power plants and the quantity is expected to increase to 8 million tonnes/annum within the next 10 years. Disposal of fly ash is an expensive operation, and it is estimated that during the fourth Five-Year Plan period, the disposal cost would be about Rs 50 millions and would be four times more in the next Plan period.

Improper disposal of fly ash could cause serious problems of air and water pollution. On the other hand, if properly utilized, not only would it offer the much needed construction materials but result in savings in disposal cost and reduction in air/water pollution. Fly ash is also useful as a fertilizer, in the treatment of sewage and in clearing oil contamination in coastal areas.

Cement and concrete industries all over the world are the largest users of fly ash and hence they are interested in its exploitation to the best advantage. While the utility of fly ash in both mass concrete and reinforced concrete constructions has been recognized in the country, a breakthrough in the utilization of fly ash on a large scale has still to take place. The Cement Research Institute of India (CRI), New Delhi has made a technical survey and an appraisal of the work on the utilization of fly ash, with particular reference to the characterization of Indian fly ash from the point of view of cement and concrete industries. All these aspects have been discussed in CRI's publication, SP-3-71, under eight heads : problem of fly ash disposal and trends; ash removal in thermal power plants: characterization of Indian fly ashes; fly ash pozzolana; fly ash in the manufacture of portland pozzolana cement; fly ash in concrete; fly ash in autoclaved products; fly ash in the manufacture of sintered lightweight aggregate; and future research and development.

The publication has brought to light several aspects of utilization of fly ash in cement and concrete, which have not been studied adequately and need further research and development. The most neglected fields of studies, according to the review, are in regard to the modes of collection, handling, transportation and storing of fly ash. The need has been stressed on finding and developing efficient collection and handling methods which will ensure supply of a reasonably uniform and standard quality fly ash from any single source. In regard to fly ash extraction and handling, development of those components of electrostatic precipitators, such as discharge electrode wires, rectifier units, which are presently being imported, could be taken up. In view of the variations in the quality of fly ash, the use of fly ash in slurry form deserves particular attention and the scope of its use in this form requires to be determined with particular reference to mass concrete constructions. In regard to the characterization of Indian fly ashes, the need has been stressed for carrying out complete analysis including determination of minor constituents like Na_2O, K_2O, TiO_2, MnO, Cl, S, SO_3, P_2O_5, as some of these are important from the point of view of pack setting of fly ash, of setting times of cements prepared from them and of concrete properties.

With regard to the use of fly ash in concrete, information is lacking with respect to: (i) properties of fresh concrete in general and workability and hardening of fly ash concrete at early periods in particular; and (ii) relationship between water-cement ratio and compressive strength of hardened concrete and between strengths of different kinds of concrete.

The publication contains a comprehensive bibliography covering the work carried out in this field between the years 1914 and 1971. Out of 646 references cited, about a hundred concern the contributions of Indian scientists.

PROGRESS REPORTS

RRL, Hyderabad

Annual Report 1969-70

Development of a process for the manufacture of activated carbon from pine wood charcoal, production of silicon carbide, splitting of *karanja* (*Pongamia glabra* Vent.) and *neem* (*Azadirachta indica*) oils, extraction of soybean meal and production of emulsion paints using styrenated drying oils are the highlights of the work of the Regional Research Laboratory (RRL), Hyderabad during 1969-70. The annual report (royal 8vo, 74 pages) of the laboratory, published recently, records the progress of the work under the following main areas of R & D work in which the laboratory is engaged: Oils and fats; Surface coatings; Organic chemistry, industrial intermediates, drugs and pesticides; Cellulose and paper; Entomology; Biochemistry; Coal; Mineral products, adsorbents and catalysts; Industrial ceramics; X-ray crystallography; Instrumentation; Chemical engineering and General engineering.

Products from castor oil containing a total monoglyceride content of 90-94% were obtained by a catalyzed glycerolysis reaction using an indigenous solvent. With slight changes in the reaction conditions, the process could be applied to groundnut and linseed oils also. An acid catalyst was successfully employed for ethenoxylation of various hydroxy materials derived from castor oil. The products were tested as emulsifiers, and a 24-mole adduct of recinoleyl alcohol was found to be the best emulsifier. Trials on a pilot plant scale were undertaken to obtain a tristearin product from castor oil by a single step process utilizing a mixed catalyst.

A 50-mm liquid cyclone was employed to obtain high-protein flour from cottonseed. As much as 36% of the feed was recoverable as product overflow, rich in protein and low in gossypol.

Pale coloured fatty acids were obtained from non-edible *neem* and *karanja* oils by splitting and distillation. Over 80% split was recorded when splitting was carried out at 25 kg/cm^2 for 5 hr without a catalyst. Studies to determine ideal conditions for obtaining good quality acid oil from sal seed soap stock were carried out. This acid oil on distillation yielded fatty acids with 71% recovery based on total fatty matter of soap stock.

Several new polymerizable monomers and their derivatives were prepared from castor oil, and their physical properties characterized. Urethanes from dehydrated castor oil (DCO), linseed or kamala seed oil, their glycerolysis products and their alkyds were prepared by reacting with toluene diisocyanate and their films were evaluated. The films of urethane alkyds showed improved alkali resistance. A simple process for the deodorization of sardine oil of high acid value, based on the treatment of the oil with acetic acid and brine solution, was developed and scaled up.

Samples of monocetyl triethyl silicate and dicetyl diethyl silicates were prepared and sent to the Ahmedabad Textile Industry's Research Association, Ahmedabad for evaluating their use as agents for increasing water repellency and crease resistance of textiles.

Emulsion paints based on styrenated linseed oil and mixtures of styrenated DCO-linseed oil were prepared and the process was scaled up to the pilot plant stage. A simple procedure for the epoxidation of oils has been standardized on a pilot plant scale.

At the instance of the Oil & Natural Gas Commission, a mixture of dimethyl isophthalate (DMI) and dimethyl terephthalate (DMT) was employed in the preparation of linseed oil glycerol alkyd on a pilot plant scale. A series of polyesters based on DMI-DMT was prepared by a two-stage reaction with ethylene glycol under alkaline conditions. Pure and modified phenol resins were prepared from cardanol and evaluated. An economical process for the preparation of tricardanyl phosphate was developed. N-aminoacyl and N-aminoalkyl-1, 2-diphenylethylamines were found to possess depressant action on central nervous system and to exhibit potent anti-inflammatory and analgesic properties.

The products of reaction of chlorodiazines and phthalazines with various substituted anthranilic and salicylic acids are being investigated for their anti-inflammatory and analgesic properties.

Processes have been worked out for the production of N-N-diethyl-*m*-toluidine; 2,5-dimethoxyaniline; 5-chloro-8-hydroxyquinoline; sodium cyclamate, diethyl sulphate; menthol from *ajwan* (*Trachyspermum ammi*) seeds; salicylaldehyde and 2-methyl-3-*o*-tolyl-4 (3H)quinazolone.

Synergism of pongamol and sesamin with carbamate insecticides was studied by applying them topically to male and female house-flies and red cotton bugs. It was found that pongamol and sesamin synergized the toxicity of isolan, pyrolon and Sevin. *Acacia arabica* seed oil and datura seed oil synergized endrin, heptachlor and certain carbamate insecticides. Field experiments with pongamol in combination with insecticides showed encouraging results.

Studies on the toxicity of isolan, endrin, malathion and heptachlor, individually and collectively with piperonyl butoxide, to cockroaches showed that endrin was more toxic than Sevin and isolan. Piperonyl butoxide was found to synergize Sevin and isolan but not endrin and heptachlor.

A study of the nature of RNA synthesized by liver cells under various conditions of organization—*in vivo*, in unperfused and perfused slices *in vitro*, and in single cells in suspension—has been completed.

An open-stack carbonizer with a capacity of 10 tonnes/batch was designed and fabricated for the Singareni Colleries Co. Ltd, Kothagudem (Andhra Pradesh). The carbonizer is producing semicoke marketed for use as domestic fuel under the trade name 'Singcoke'. A fixed-bed carbonizer with a capacity of 700 kg/day was operated continuously; about 7 tonnes of pine wood were carbonized.

In the manufacture of polystyrenes, 4-*tert*-butylcatechol is used as a stabilizer, and is imported at present. Studies were undertaken to produce 4-*tert*-butyl alcohol from catechol, which is available at the Neyveli carbonization plant. Conditions were established for converting about 75% of catechol to 4-*tert*-butylcatechol using $ZnCl_2$ as catalyst.

About 1.5 tonnes of active carbon from pine char were produced and supplied to the sponsor, Hypine Carbons Ltd, New Delhi. Evaluation and processing of fuller's earth, supplied by Kamal Mineral Industries, Hyderabad, was undertaken and the activation process was demonstrated to the sponsor who are setting up a 5-tonne/day plant at Hyderabad.

Technical assistance was rendered to Micro Ceramics Ltd, Hyderabad, who are manufacturing pyrometric cones based on the process developed by the laboratory. A pilot plant furnace with a capacity for producing 3 tonnes/run of silicon carbide was designed, constructed and commissioned.

Developmental work on X-band ferrites required by the Defence Electronics Research Laboratory, Hyderabad has been completed successfully.

During the year under report, fifteen processes were released for commercial exploitation and nine feasibility and project reports were supplied to industry.

Fifty-three research papers were published, and five patents were filed and four patents were accepted.

CSIR SUPPORT TO RESEARCH

Completed Schemes

Angular Correlation Studies using High Efficiency Sum-Coincidence Scintillation Spectrometers

Systematic investigations have been carried out on the radioactive decay of ^{59}Fe and ^{198}Au and also on the K X-ray and gamma-ray angular correlations in the decay of ^{113}Sn, ^{114}In, ^{133}Ba, ^{153}Gd and ^{186}Re using high efficiency 'sum and sum-peak coincidence' techniques employing a slow-fast coincidence arrangement. The investigations were made by Shri K. Venkata Ramana Rao, a CSIR research fellow, at the Department of Nuclear Physics, Andhra University, Waltair from Sep. 1969 to Feb. 1971 under the guidance of Prof. V. Lakshminarayana of the Department. Very accurate measurement of small anisotropies of X-ray and gamma-ray cascades, even of varied intensities, was possible with the set-up employed. Observations made on the effect of nuclear environment and the type of beta decay on K X-ray and gamma-ray angular correlations support the theory of Dolginov [*Nucl. Phys.*, **2** (1956/57), 723; *Soviet Phys. JETP*, **7** (1958), 644], which denies the existence of any correlation, and contradicts the findings of Perepelkin [*Soviet Phys. JETP Lett.*, **5** (1967), 81].

The decay scheme of ^{59}Fe was investigated and the results were utilized in evaluating the nature of the gamma-ray transitions and their mixing ratios. The quadrupole content of the gamma-ray transitions was obtained for different spin possibilities, and the properties of the nucleus of ^{59}Co were studied.

Theoretical analysis of the decay of ^{198}Au has indicated the presence of a monopole contribution to the 676 keV transition in ^{198}Hg. The nature of the 2^+ state was also examined. From a detailed theoretical analysis of the experimental results, the applicability of the various nuclear models proposed so far was examined. The models tested included Grechukin's model based on single particle model [*Nucl. Phys.*, **40** (1963), 422], Davidov and Fillipov's model based on collective model [*Nucl. Phys.*, **8** (1958), 237] and microscopic models proposed by Alaga *et al.* [*Phys. Lett.*, **22** (1966), 619; *Nuclear structure and nuclear reactions* (Academic Press Inc., New York), 1969] and Covello and Sartoris [*Nucl. Phys.*, **A104** (1967), 189]. The analysis has revealed that the above models are inadequate to describe the second 2^+ state in ^{198}Hg since the experimental results indicate an admixture of particle and collective excitations in the 676 keV transition in ^{198}Hg.

Shri Venkata Ramana Rao was awarded the Ph. D. degree (1971) of the Andhra University, Waltair for his thesis relating to the studies.

Capacitance Behaviour of Bipolar and Unipolar Devices

Detailed theoretical and experimental investigations of the capacitative behaviour of the bipolar (alloy junction and diffused planar junction) and the unipolar (p-channel junction field effect transistor) devices have been made by Shri S. C. Prasad, a CSIR research fellow. The investigations were made under the supervision of Dr M. Misra at the Department of Physics, University of Gorakhpur, Gorakhpur from September 1969 to September 1971.

Theoretical and experimental investigation of the current dependence of collector junction capacity of an alloy junction transistor under IOC is of importance in the study of transient response. It has been observed that the output collector junction capacity varies more rapidly with the injected minority carrier current density than that in normal mode as observed earlier by Collard and Sterzer [*Appl. Phys. Lett.*, **45** (1964), 165].

The physical mechanism of capacitative behaviour of silicon diffused planar junctions was studied by obtaining the real impurity profiles for the junctions of high frequency transistor on the basis of Opdorp's theoretical analysis [*Solid-St. Electron.*, **11** (1968), 397] and also on the basis of log C *vs* log V plot. The observed impurity profile provides interesting information regarding the collector-to-substrate interface (which is of nn* type) and also shows good agreement with the results obtained from other methods. Further, a theoretical and experimental investigation of the C-I characteristics of these junctions has also been made to obtain additional information regarding the high injection level phenomena. The observed behaviour of C-I characteristics in the IOC has been interpreted in terms of the formation of field induced junction on the base-epitaxial layer interface [*Solid-St. Electron.*, **10** (1967) 305].

A study of the physical theory of capacitative behaviour of the field effect devices was also made. Starting from the elementary theoretical considerations of gate-source space-charge layer capacitance in the pre-pinch-off region, due to Dacey and Ross [*Bell Syst. tech. J.*, **34** (1966), 1149], Lindholm and Latham and Spengebu [*Proc. IEEE*, **51** (1963), 404 ; **53** (1965), 1165] and taking into consideration the effect of field dependent mobility and carrier drift velocity saturation, a more appropriate theory suitable for field effect structure has been developed for C_{gs} for different biasing configurations. A physical theory for drain-source capacitance has also been developed using a two-region physical model due to Grebene and Ghandhi [*Solid-St. Electron.*, **12** (1969), 573] and also by taking into account the effect of carrier drift velocity saturation.

The effects of low temperature on the transfer power characteristic of JFET and on the diffusion capacity of an alloy junction transistor and the effect of magnetic field on the slope of $1/\alpha_{cb}$ *vs* I_e at high injection level of an alloy junction transistor have also been investigated.

Electrodeposition of Iron Alloys

Studies on the electrodeposition of binary and ternary alloys of iron, viz. iron-cadmium, iron-cobalt-cadmium and iron-cobalt-zinc alloy systems, from the sulphate bath have been made by Shri S. K. Narang, a CSIR research fellow working under the supervision of Prof. T. L. Ramachar, at the Department of Inorganic & Physical Chemistry, Indian Institute of Science, Bangalore. The effect of the common plating variables on deposit composition, cathode potential and cathode efficiency was investigated in order to obtain optimum conditions for securing sound, dense, adherent, macroscopically homogeneous and bright deposits. The variables investigated were : bath composition (variation [illegible] the concentration of individual metals as well as all metals), temperature, pH, agitation of bath, and effect of various additives such as metal ions, neutral salts, surface active chemicals and brighteners.

Sulphate bath has been found to be satisfactory for the deposition of these alloys. By a suitable variation of the conditions of deposition, a wide range of compositions could be obtained, viz. (i) 0-91% iron at a cathode efficiency of 10-93% at high current densities up to 100 A/dm^2 in the case of iron-cadmium system; (ii) 0-62% iron, 0-60% cobalt and 0-100% cadmium in the case of iron-cobalt-cadmium system at current efficiencies of 46-99% and current densities up to 30 A/dm^2; and (iii) 0-60% iron, 0-63% cobalt and 5-100% zinc at current efficiencies of 4-99%; and a maximum current density of 20 A/dm^2 could be applied in the case of iron-cobalt-zinc system.

PATENTS ACCEPTED

Indian Pat. 126439

Improvements in or relating to the preparation of phosphor grade zinc sulphide material useful for luminescent devices
C. V. Suryanarayana & (Miss) A. Kurian, CECRI, Karaikudi

For the preparation of phosphors for use in electroluminescence, cathode luminescence, X-ray and other photoluminescence devices a special variety of zinc sulphide, the basic starting material, is required. Several methods are available in literature for the preparation of zinc sulphide either by a heterogeneous reaction of an appropriate zinc compound with gaseous hydrogen sulphide or by liquid phase reactions involving soluble zinc salts and inorganic alkali sulphides or organic thio compounds in various media. These methods are tedious and time-consuming as they involve two or more steps. Further, the zinc sulphide produced can be rarely used directly without further purification for achieving sensitizations for the appropriate type of luminescence to be excited subsequently.

The process covered by this patent gives zinc sulphide in one step and the product is obtained in good yields and can be used directly for subsequent sensitization appropriate for end use. The process consists essentially in reacting a zinc salt in aqueous medium at normal temperatures with an aqueous solution of an organic thio compound like thioacetamide, thiourea or their substituted derivatives in the presence of a strong alkali adjusted to optimum pH. A novel feature of the process is that a graded non-stoichiometry can be obtained by correspondingly grading the pH of the medium. It is possible to obtain perfectly white zinc sulphide required in some processes.

Indian Pat. 124758

Improvements in or relating to a mechanical integrator
B. M. Sen, T. R. Gururaja Rao & S. N. Ray CMERI, Durgapur

A mechanical integrator integrates a plurality of displacements or velocities which may be linear or angular and gives the output in digital or analogue form. The patent relates to an improvement of existing types of mechanical integrators to specially suit certain applications. In this, two types of motion, viz. rotational velocity and linear displacement, are integrated to get a single rotary output. Integration and transmission of the motions to the output shaft are effected by friction between working elements. The device consists of: (i) a disc which is subjected to rotary motion, (ii) a pair of spheres transferring the rotary motion from the disc to a cylinder, and (iii) mechanical linkage to position the pair of spheres at an input displacement on radial distance from the axis of the disc whereby the speed of rotary displacement of the cylinder is an integrated output of the two inputs. The integrated output can vary from zero to any maximum value which is limited on the diameter of the disc. Since the method of transmission of motion is by friction, care is taken to reduce the frictional losses to a minimum by: (i) close control of dimensional tolerances, backlash and alignments in the shafting and linkages; (ii) use of antifriction bearings for the disc, cylinder and spheres and hardened rigid construction with true surface finish for the disc, spheres and cylinders; and (iii) prevention of ingress of dust oil or moisture, etc. at the contacts. The relation between the rotary output to linear motion is checked during calibration, so that it is practically linear within a close tolerance, i.e. the slip which occurs normally in such mechanisms has been reduced considerably by a proper spring pressure which controls the radial force between the disc and spheres, and also between spheres and cylinder, taking into account even the smallest wear or misalignments. As continuous operations produce considerable heat and there may be thermal distortion, the heat is effectively dissipated by the fins and convective air current is guided by deflectors provided in the casing of cast aluminium. The life of the mating parts is increased by proper selection of material and heat treatment to the required hardness, tapping and burnishing. The working parts are enclosed in the casing which is dust-proof and is provided with inspection covers. All bearings are lubricated for life. This construction has a good efficiency of integration with quick response in addition to being robust and handy.

The mechanical integrator covered by the patent finds various applications in computing machines for integration and also for differentiation with a few additional accessories. It can be used in industrial devices such as continuous weighting device for conveyors to integrate the speed (or roller table speed) and transient payload, giving the rate of flow of material as also the cumulative flow of material as outputs. The device can also be used as a speed variator in fractional horsepower drives such as control systems.

PATENTS FILED

133791: Improvements in or relating to the manufacture of cyclohexanone-oxime from cyclohexanone, V. S. B. Rao, K.W. Gopinath & M. S. Iyengar—RRL, Jorhat.

133792: Improvements in or relating to laboratory model freeze drying units, S. C. Srivastava, P. Dhar, P. Bhargava, K. K. Saroj, V. Subarao, A. S. Rao & G. S. Chowdhury—RRL, Bhubaneswar.

133793: Improvements in or relating to a process for the preparation of fish protein concentrate and fish flour from marine fishes, K. K. Saroj & G. S. Chowdhury—RRL, Bhubaneswar.

133794: Improvements in or relating to immersion coolers, cold temperature immersion thermostats with circulating bath and like equipment, S. C. Srivastava, P. Dhar, P. Bhargava & G. S. Chowdhury—RRL, Bhubaneswar.

133844: An improved process for the production of monochloroacetic acid by catalytic chlorination of acetic acid, M. S. Anand & C.S.B. Nair—CFRI, Dhanbad.

133893: A draw-off tap for fluids, B. K. Agarwal & A. K. Agarwal—NPL, New Delhi.

133894: A process for manufacture of cystine from hair, P. M. Amin, M. Chakravarty, J. N. Baruah & M. S. Iyengar—RRL, Jorhat.

133921: Siliconized oil based fatliquors, K. J. Kedlaya, V. V. Muralidhara Rao, (Smt.) K. Vijayalakshmi & D. Ramaswamy—CLRI, Madras.

133922 : Gravity mixer for solid materials, G. C. G. Reddy, T. K. Reddy & T. S. R. Anjaneyalu—RRL, Hyderabad.

133961 : Improved orange juice extracting machine, A. R. Ramesh—CFTRI, Mysore.

134017 : A bath for making silver powder by electrolysis, D. Sen—NPL, New Delhi.

134018 : A process for the preparation from seed-lac (button-lac or shellac), without the use of much methylated spirit, of a French polish for wooden furniture, J. G. P. Srivastava—NBG, Lucknow.

134019 : A bath for making silver powder by electrolysis, D. Sen—NPL, New Delhi.

PATENTS SEALED

109906: Improvements in or relating to video amplifiers, J. P. Raina & N. N. Seru—CEERI, Pilani.

113406: A new thermistor composition exhibiting high positive temperature coefficient of resistivity (posistor), B. G. Brahmecha & K. P. Sinha—NCL, Poona.

113506: Improvements in or relating to prevention of tarnishing of copper, and gold and silver plated copper, K. S. Rajagopalan & R. Aravamudan—CECRI, Karaikudi.

113777: Improvements in or relating to indigenous visible dye penetrants for surface and sub-surface flaw detection, S. G. N. Swamy—CMERI, Durgapur.

113869: Improvements in or relating to the preparation of calcium tungstate blue phosphor, C. V. Suryanarayana, M. I. A. Siddiqi, R. Lakshminarayanan, N. Rajaram, S. Balachandran & R. Kalyanasundaram—CECRI, Karaikudi.

114277: A process for the recovery and purification of naphthalene from impure grades of naphthalene including crude naphthalene oil, C. S. B. Nair, D. K. Sen, A. N. Basu & A. Lahiri—CFRI, Dhanbad.

117210: A direct process for the manufacture of dibutylin di-iodide and of the oxide therefrom, J. Gupta, C. Gopinathan, (Mrs), S. Gopinathan & P. A. Awasarkar—NCL, Poona.

118256: Improvements in or relating to electrolytes for the electrochemical marking of metals, S. Guruswamy—CECRI, Karaikudi.

Seminar on Petroleum Speciality Products

A two-day seminar on Petroleum Speciality Products is being organized by the Indian Institute of Petroleum, Dehra Dun during May-June 1972. Technical sessions will cover: (1) Review of demand and consumption pattern of petroleum speciality products; (2) International and Indian specifications of these products: the need, if any, for changing them in the context of availability of raw materials and actual service conditions in the country; and (3) Import substitution, indigenous production and know-how.

The seminar would be in the nature of a get-together of manufacturers, importers, users and R & D organizations concerned with the petroleum specialty products, and would focus the problems being faced by manufacturers and users and R & D work being done in the country for import substitution.

Further details may be obtained from the convener of the seminar, Dr R.K. Srivastava, Indian Institute of Petroleum, Dehra Dun.

Air Pollution News Letter

The Central Public Health Engineering Research Institute (CPHERI), Nagpur is bringing out a news letter entitled 'Air pollution News Letter' from this year. Issued quarterly, it highlights the air pollution activities in India and would be useful to all those bodies concerned with pollution problems.

The first issue of the news letter, brought out in January 1972, deals with the progress of some of the projects on hand at CPHERI and its zonal laboratories in the field of pollution, such as: national air sampling network; air pollution survey in Bombay; study of the atmospheric conditions in the proposed twin city of Bombay, air pollution survey in Calcutta; etc.

The news letter also notices conferences dealing with the pollution problems and lists papers published in the field.

The institute is a WHO Regional Reference Centre on Air Pollution.

Current Literature on Science of Science

This is the title of the abstracting journal which is being issued in place of Index to Literature on Science of Science by the Research Survey and Planning Division of CSIR in association with Insdoc and PID. The journal contains indicative abstracts of articles dealing with the following aspects of science and technology: (1) planning, (2) policy, (3) politics, (4) history, (5) organization, (6) expenditure, (7) management, (8) education, (9) manpower, and related areas. The entries are grouped under broad subject headings arranged in alphabetical sequence. The first issue of the journal, brought out in January 1972, contains 92 abstracts of articles culled from 36 different periodicals.

As observed by the Director General, Scientific & Industrial Research, in his foreword to the inaugural issue, the journal would serve as a medium for dissemination of information to scientists, technologists, industrialists, policy makers and planners on recent developments in the field of science of science.

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Recovery of Nickel, Phenol and Zinc from Solutions using Ion-exchange Technique

The use of ion-exchange resins for the recovery and concentration of nickel, phenol and zinc from dilute solutions has been investigated by Shri U. D. Datar of the Central Salt & Marine Chemicals Research Institute, Bhavnagar, who carried out the study under the supervision of Dr N. Krishnaswamy. In the case of zinc, besides ion-exchange resins, the electrodialysis technique using ion-exchange membranes was employed.

The recovery of nickel from Raney nickel catalyst waste consisted of the following steps: (i) removal of the adhering fat by solvent extraction, (ii) leaching of the fat-free catalyst with a mineral acid such as sulphuric acid; (iii) concentration of nickel from the acid leach solution using cation-exchange resins Tulsion-14, Zeokarb-225 and Amberlyst-15 in their hydrogen and sodium forms; and (iv) elution of nickel from the resins using either 10% solutions of sulphuric acid or sodium formate.

No change in the breakthrough performance of Tulsion-14 and Zeokarb-225 (hydrogen or sodium forms) was observed when the exhaustion flow rates were varied. The elution performance of Zeokarb-225 was affected when the elution flow rate was varied with sulphuric acid and sodium formate solution. The elution performance of Tulsion-14 was affected only when regeneration was effected with sodium formate solution, but with sulphuric acid, variation in flow rate did not affect the elution performance. Amberlyst-15 showed almost similar absorption and elution performance characteristics as Zeokarb-225, and during elution of Tulsion-14 and Zeokarb-225 with sodium formate solution, nickel formate precipitated in the first few lots of the effluent.

The results confirmed that the cation exchangers Tulsion-14 and Zeokarb-225 could be used in their sodium form for the recovery of nickel from its dilute acidic solutions. Sodium formate solution (10%) could be successfully used for elution of nickel, since most of the absorbed nickel is eluted and precipitated as nickel formate in the eluted fractions.

Phenol uptake by the anion-exchange resins Deacidite-HIP, Amberlyst-21A, Amberlite-IR45 and Tulsion-WB, and the cation-exchange resins Tulsion-14 and Zeokarb-216 was studied at varying concentrations of phenol, *p*H of phenol solution and influent flow rates, and in the presence of strong electrolytes. Recovery of phenol was studied using different eluting agents.

The phenol uptake capacity of anion-exchange resins was found to depend on their basicity. A resin having strong anion-exchange groups showed greater capacity than a resin having weakly basic groups; resins in their hydroxyl forms showed greater capacity than in their salt forms and the difference was greatest with strong-base resins but least with weak-base resins. The absorption capacity increased as the concentration of phenol in the equilibrating solution increased. The *p*H of phenol solution did not affect phenol uptake by different resins. The absorption capacities of Tulsion-WB and Amberlyst-21A were unaffected when the exhausting flow rate was varied and also in the presence of sodium chloride. Different alkaline solutions and methyl alcohol could be used as eluting agents but the latter gave the best performance. Tulsion-14 and Zeokarb-216 showed better phenol absorption capacity than Zeokarb-225 and Amberlyst-15.

Phenol could be absorbed by and recovered from a weak-base anion-exchange resin in the hydroxyl or chloride form, as the absorption capacity of such a resin was not affected by phenol solutions, varying *p*H, or by the presence of a strong electrolyte. Phenol could be successfully eluted using methyl alcohol and separated from the eluate by distillation.

The recovery of zinc from acidic rayon factory waste using both cation-exchange resins and membranes was studied by: (i) absorption on Tulsion-14 and Zeokarb-225 in their hydrogen and sodium forms; (ii) elution of zinc by solutions (10%) of sulphuric acid and sodium sulphate; and (iii) using only cation-exchange membranes in an electrodialysis cell. After deacidification of the waste employing a weak-base anion exchanger in the hydroxyl form, zinc uptake by Tulsion-14 and Zeokarb-225 in their sodium forms was investigated.

The breakthrough performance of the cation-exchange resins, Tulsion-14 and Zeokarb-225 in hydrogen and sodium form was affected when the exhaustion flow rate was varied. The elution performance of Zeokarb-225 was affected when the elution flow rate was varied. Deacidification of waste by a weak-base anion-exchange resin in hydroxyl form was better in the upflow direction than in the downflow direction, and precipitation of zinc hydroxide on the resin column was avoided. Deacidification of waste improved zinc uptake by the resins in the sodium form. Zinc could be recovered as a precipitate in the exchange membranes and sodium carbonate solution as the electrode wash.

The results of the investigations point to the conclusion that zinc could be recovered from the acidic rayon factory waste by indigenously available cation exchangers in hydrogen or sodium form. Zinc could also be recovered by the cation exchanger in sodium form after deacidification using a weak-base anion exchanger (also indigenously available) in hydroxyl form. Similarly, zinc could be recovered by electrodialysis technique using only cation exchange membranes. The use of sodium carbonate or similar alkaline solutions as electrode wash enables easy removal of zinc as precipitate in the cathode chamber.

Shri Datar was awarded the Ph.D. degree of the Gujarat University, Ahmedabad, for his thesis relating to the studies.

Formed Coke from Korean Anthracite

A feasibility study on the production of formed coke from Korean anthracite and Korean asphalt binder was undertaken, and completed, by the Central Fuel Research Institute, Dhanbad under an ECAFE project.

Laboratory and pilot plant experiments have shown that briquettes suitable for domestic and/or industrial use could be made by proper processing. In laboratory experiments, 4% binder was found to be optimum. The crushing strength of cylindrical briquettes produced on a laboratory scale conformed to the requirements of domestic and industrial use. As Korean asphalt is a high sulphur binder, the sulphur content in the formed coke was greater than 1%.

In pilot plant experiments, 7% binder was used with a view to producing metallurgical briquettes. The cured briquettes were sufficiently strong and hard for metallurgical use. The point crushing strength of the ovoid briquettes produced was found to be about 150 kg. Further carbonization yielded stronger briquettes but produced more of fines. Finer crushing of anthracites improved both the strength and hardness of briquettes produced in both laboratory and pilot plant trials.

Ceramic Microphones

Ceramic microphones have been developed by the Central Electronics Engineering Research Institute, Pilani. These microphones use PZT (lead zirconate titanate) elements as the transducer, which use the piezoelectric property of the polycrystalline poled PZT ceramics. This is an extention of the project on ceramic phonograph pickup, which has already been taken up by industry for commercial production.

The specifications of the microphones are : frequency response, 70 Hz to 8 kHz (within ± 10 db); sensitivity, −62 db below 1 V/dyne cm^2; and load impedance, 1 megohm or more.

Ceramic Microphone developed by CEERI, Pilani

These types of microphones are most suited for commercial tape-recorders, public address systems, and in general for two-way communication systems in which high fidelity is not the prime consideration.

Preparation of Hydrobromic Acid and Alkali Metal Bromides using Ion-exchange Resins

Studies on the preparation of hydrobromic acid and alkali metal bromides employing ion-exchange resins have been made by Shri B. T. Mandalia at the Central Salt & Marine Chemicals Research Institute, Bhavnagar, under the guidance of Dr N. Krishnaswamy of the institute.

In the preparation of hydrobromic acid from ferrous bromide using Zeokarb-225 cation-exchange resin by the column technique, the variables studied were : (i) flow rate of influent, (ii) concentration of influent, (iii) mesh size of resin, (iv) bed height of resin, and (v) use of multiple columns.

Resin capacity realized at breakthrough was 46.6% when 2.5 *N* ferrous bromide solution was passed at a flow rate of 9.0 ml cm^{-2} min^{-1} through the resin (−25+52 mesh) in the hydrogen form filled to 60 cm height. A high degree of column utilization was achieved when two columns instead of one were used.

The effect of flow rate and concentration of influent on the breakthrough capacity using ferric bromide alone and a mixture of ferric bromide and ferrous bromide was compared with the effect when ferrous bromide alone was used. The results indicate that as the concentration of the solutions is increased at constant flow rate, the decrease in the breakthrough capacity is more pronounced with ferric bromide than with ferrous bromide or their mixture. As the flow rate is decreased the difference in breakthrough capacity also decreases. At a flow rate of 3.0 ml cm^{-2} min^{-1}, the per cent resin capacity realized was the same for all the solutions of 2.5 *N* concentration.

After 60 cycles of operation there was practically no change either in the capacity of the resin or in its mesh size. The acid obtained conformed to A.R. specifications.

Sodium bromide could also be used to prepare hydrobromic acid using the column technique, though the per cent resin capacity realized at breakthrough was slightly lower than when a solution of potassium bromide was used.

Absorption of hydrobromic acid by a weak-base anion exchanger was studied under static conditions by varying the concentration of acid, amount of resin, mesh size of resin and temperature.

The capacity of Tulsion WB (hydroxide form) to absorb hydrobromic acid increased as the concentration of the acid was increased. The capacity of the resin particles of smaller size was slightly greater.

T[illegible]sion WB, being a weak-base resin, loses its capacity at higher temperatures.

Sodium bromide and potassium bromide were prepared from a mixture of ferrous bromide and ferric bromide using Zeokarb 225 cation-exchange resin in the appropriate salt form. Sodium bromide and potassium bromide could be prepared from iron bromide using the ion-exchange technique. Per cent resin capacity realized at breakthrough was higher in the preparation of sodium bromide than in the case of potassium bromide. The resin bed in the ferrous form could be regenerated efficiently using 0·5 *N* sodium citrate solution.

Shri Mandalia was awarded the Ph.D. degree of the Bombay University, Bombay for his thesis relating to the studies.

Metabolism of Plant Cells Grown *in vitro*

Tissues of several dicotyledonous plants have been grown in tissue culture, but reports on the isolation of callus cultures from monocotyledonous plants, especially cereals, have been meagre. Studies on the nutrition, metabolism and differentiation of these economic crop plants in tissue culture can be of potential value in crop improvement. With this objective, investigations were carried out with different cereals, and callus cultures were initiated from stem or root segments of seedlings of four cereal plants, viz. *Zea mays* (maize), *Triticum vulgare* (wheat), *Oryza sativa* (rice) and *Sorghum vulgare* (sorghum). The studies were made by Shri A. F. Mascarenhas of the National Chemical Laboratory, Poona, under the guidance of Dr V. Jagannathan of the laboratory.

The callus tissue from the cereals was obtained on an agar medium containing modified Smith's mineral salts, vitamins, a protein hydrolyzate, inositol, naphthalene acetic acid (NAA) and sucrose. Better growth was obtained with rice by further supplementation of the medium with adenine, guanine and tyrosine. These media together with a number of others were used for growing the tissues routinely for over 5 years by subculture every 45 days.

The nutritional requirements of these tissues were studied in detail. Of the different mineral salts media tested, Smith's medium was adequate for all the cultures although rice tissue gave maximum growth on Murashige and Skoog's medium.

All the cereals could grow well on a purely organic nitrogen medium or with ammonium nitrate, or with nitrate alone even on repeated subculture.

A carbohydrate source was found to be essential for the growth of all the cereals, the best being either sucrose or glucose. These cultures are among the few plant cultures that can utilize starch as the sole carbohydrate source.

No specific requirement was observed for a cytokinin, gibberellic acid, or inositol, although diphenylurea and inositol gave a slight stimulation in growth.

An essential component of the medium was an auxin, without which the tissues died. In the presence of α-naphthalene acetic acid good growth was obtained in the case of all the tissues. These cereal cultures had high NAA tolerance, and did not die even at 20 ppm. The optimum concentration of NAA was also fairly high (5-10 ppm).

The vitamin requirements, in the form of thiamine, pyridoxine and nicotinic acid, of the cereal tissues were also much higher—5 to 10 times more than the concentrations normally used for growing most of the plant cultures.

The growth curves of all the cereals showed lag, exponential and stationary phases, the only differences being in the duration of the different periods.

Maize, wheat and sorghum tissues grew on agar media as a mixture of varying amounts of callus and roots, whereas rice cultures grew only as callus. The proportion of roots increased with the age of the culture.

When maize, wheat and sorghum tissues were transferred from agar cultures to liquid medium of the same composition in shake flasks agitated on a rotary shaker at 120-180 rpm, the tissue was found to differentiate into a mass of roots having a number of laterals. There was virtually no callus growth. Rice, however, did not differentiate. The capacity of agar cultures to form roots in liquid medium did not diminish even after 3 to 5 years. These root cultures in liquid media were also maintained by repeated subculture under shake flask conditions on different media for over 3 years. Maize roots grown in liquid cultures had a markedly higher growth rate compared to agar cultures.

Nutritional studies were also carried out on maize roots. Their requirements were more or less identical to those of the corresponding callus cultures. A major difference was in the response to abscisic acid, which at 0·1 ppm completely inhibited the growth of maize roots. In agar cultures (which consist of a mixture of callus and roots) the root growth was selectively and completely inhibited by abscisic acid, whereas the callus tissue continued to grow. This indicated a selective inhibitory effect of this compound on root growth.

Experiments on the rate of utilization of phosphorus, organic nitrogen, sucrose and iron were carried out with maize and wheat roots. Practically all the phosphorus was taken up by about the 18th day, and nitrogen and sucrose by the 31st day. At this stage more than half of the iron was still present in the medium. A similar uptake of nutrients was also observed in the case of wheat roots, though the rate was not as rapid due to a slower growth of this tissue.

A striking feature of these root cultures was the reversibility of the differentiation. Cereal root cultures grown in liquid media reverted to their original appearance of a mixture of callus and roots when washed and transferred to agar.

A comparison was also made of the concentrations of a few glycolytic, HMP pathway, citric acid cycle and hydrolytic enzymes in extracts of callus and root cultures of maize and wheat grown on agar and in liquid media. Maize roots had a higher content of malic enzyme and glucose-6-phosphate dehydrogenase and a lower content of pyruvate kinase than the corresponding callus tissues. Similar differences were observed in the case of wheat callus and root cultures. The concentrations of other enzymes in callus and root extracts were not significantly different.

Shri Mascarenhas was awarded the Ph.D. degree of the Poona University for his thesis relating to the study.

Proceedings of Symposium on Electro-acoustics

The proceedings of the symposium on Electro-acoustics, held at the Central Electronics Engineering Research Institute (CEERI), Pilani, in September 1970, have been published by the institute. The publication (140 pages) contains three keynote addresses and 17 research and review papers presented in the three technical sessions : Electro-acoustics Components; Architectural Acoustics, Education and Standards; and Recording, Reproduction and High Fidelity.

Free periodic vibrations of an undamped non-linear two-degree of freedom system have been analysed and the results presented in a paper by G. V. Anand, Indian Institute of Science (I.I.Sc.), Bangalore. The use of an electrostatic loudspeaker in hi-fi sound system has been discussed by T. N. Pranesha of I.I.Sc., Bangalore. A new method of construction of the loudspeaker in which two push-pull electrostatic loudspeaker units are sandwiched to form a cascaded system, thus eliminating short-circuiting hazards, has been proposed and a model fabricated with indigenous components. The design of a stereo pickup for use with stereo recordings is discussed in a paper presented by J. D. Jain and G. S. Diwakar of CEERI, Pilani. The transducing elements are bimorphs made of PZT ceramic pieces. The frequency response of the stereophonic pickup is uniform within ±5 db from 50 to 10 000 Hz and the channel separation is 20 db at 1 kHz. The sensitivity per channel is 150 mV for a recorded velocity of 5 cm/sec rms.

Record reproduce heads have an important role in magnetic recording systems. M. R. Kapoor, K. L. Kataria and K. D. Pavate of CEERI, Pilani have described the factors involved in the design of tape heads suitable for use both in professional equipment and equipment needed for entertainment and educational purposes. The core metal used is laminated Mu-metal and the assembly is potted in a casing which shields the head from stray electrostatic and magnetic fields.

The session on Architectural Acoustics, Education and Standards included six, of the seven papers presented, from I.I.Sc., Bangalore. One of them pertains to the planning and constructional details of a new acoustics laboratory which was designed and set up in the Electrical Communication Engineering Department. The features of the laboratory are : an anechoic chamber for producing free field conditions, a reverberation chamber for producing diffuse sound field conditions and a recording studio for producing variable acoustical conditions. Y. S. Venkateswaran and S. Mukhopadhyay of the Indian Standards Institution (ISI), New Delhi reviewed the standardization work of ISI in acoustics and electro-acoustics. A brief summary of the work done at the international level through ISO and IEC is also included.

The method developed by the Research Department of All India Radio for the production of standard test tapes is dealt with in a paper presented in the final session.

An important paper included in this session relates to the work of CEERI, Pilani on the design and development of a tape recorder. The performance characteristics of the tape recorder are also given.

PROGRESS REPORTS

CMRS Annual Report : 1970-71

The annual report of the Central Mining Research Station (CMRS), Dhanbad for 1970-71, which has been published recently, records projectwise the progress of research under the following disciplines: Mine technology; Mine safety; Mine engineering; Mine health; and Mine air pollution. Seventy-seven projects in all were investigated, including 23 projects taken up during the year; work on 15 projects was completed.

Roof bolt anchorage investigations were completed in 12 mines, and a proper bolting pattern was recommended. Comprehensive roof bolting investigations were also completed in three mines and were continued in two other mines. Strata control investigations were conducted in a longwall face of a pyrite mine, a coalmine working on bord and pillar method without stowing, and a coalmine longwall face with sand stowing.

A problem referred to by the Coal Board regarding the adjustment in the stock of sand in its central ropeway scheme was studied; 885 sand samples were analysed for moisture content and 540 bulk density tests were made.

Investigations to assess the suitability of using coir matting as a barricading material for sand stowing in mines were continued; work on this project was taken up at the instance of the Coir Board. Coir matting has been found to be 3 to 8 times stronger than the conventional barricading materials such as brattice cloth, hessian, bamboo matting. A saving of about 63% in the cost of barricading materials could be achieved in a colliery by the use of coir matting in place of bamboo matting. At the instance of a public sector undertaking, the efficiency of blasting in an iron ore mine was investigated to work out ways and means of making the best utilization of the existing equipment. Some changes in the pattern of drilling and blasting were suggested. This led to considerable reduction in cost. Projected over the whole year's production of the mine, the savings in drilling and blasting costs are expected to amount to several lakhs of rupees.

Eight exploders (seven indigenous) and multi-shot blasting equipment were investigated and tested for performance and safety. One indigenous safety caplamp was subjected to hot filament ignition and intrinsic safety tests and was found suitable for use in atmospheres of pentane class. At the instance of an indigenous manufacturer of explosives, tests on 8 samples of P_1, P_2 and P_3 explosive compositions were carried out to find out their certifiability for inclusion in the respective groups. The flammability of a coal sample was determined and the results were communicated to the party concerned. As many as 1070 gas samples were analysed. Gas mask canisters from the Fertilizer Corporation of India and the Kolar Gold Mining Undertaking were tested and [illegible]sults reported to the parties. The optimum concentration of a sample of non-ionic detergent (received from Balmer Lawrie and Co. Ltd, Asansol), required for coal dust suppression, was evaluated and a report submitted. Studies on self-heating characteristics of different coals have shown that if the quantity of air per tonne of coal is greater than 3.4 m^3/min, the chances of self-heating are reduced considerably, whereas 1.7-2.3 m^3/min of air per tonne of coal is sufficient to initiate self-heating, particularly for high moisture coals which are highly susceptible to spontaneous heating. Technical advice in regard to the production of safety torches, flame safety helmets and gas indicators was rendered to five organizations.

An important achievement in the field of mine engineering was the development of an automatic lubricator for winding wire ropes. Over 800 indigenous and 91 imported wire ropes were tested in the laboratory to evaluate the influence of service conditions on rope characteristics. Thirteen steel friction props, two hydraulic props, two sets of steel link bars and one set of slide bar head were tested with a view to finding a substitute for sal, which is traditionally used as mine support material in India and is in short supply. These investigations are also intended to assist in the development and manufacture of steel friction prop, hydraulic prop and steel link bars. The cable fault locator, developed earlier, was modified to make the device more sensitive and to increase the range of its application.

The mine health group continued the study of dust problem in coal mines and associated diseases. Another study was concerned with the physiological evaluation of miners' work in regard to energy expenditure in different mining operations.

Several electron micrographs of lung dust and air borne dust were analysed. Air borne dust surveys were conducted in two coal mines, one gold mine, a sulphuric acid plant and two cement factories.

A patent relating to 'hydraulic prop incorporating a load indicating device' was filed, and 50 research papers were published.

The revenues accruing to the laboratory from its technical services amounted to about Rs 5.07 lakhs during 1970-71.

CSIO Annual Report : 1970-71

The annual report of the Central Scientific Instruments Organization (CSIO), Chandigarh for 1970-71, shows that as many as 10 new instruments/components were developed during this period. A salient feature of the work of CSIO is its increasing involvement with industry and research institutions at whose instance the design and development of a number of instruments and components was taken up. Seven sponsored projects were completed and four were under investigation.

A foetus monitor which can (i) detect the condition of foetal heart in early pregnancy; (ii) indicate placental localization; (iii) confirm intra-uterine deaths; and (iv) detect the presence of twins (accuracy 100%), has been developed. A low cost solid state operational amplifier, useful especially in computation, has been developed.

A non-contact type electromagnetic transducer for measuring angular and linear speeds has been developed using indigenous componets. A battery operated portable non-contacting electronic tachometer, used in conjunction with a non-contact type speed probe and ferromagnetic gear combination, for the direct measurement of speed of a rotating shaft or object (range, 1-10^4 rpm; accuracy, ± 2%) has been developed using indigenous components.

At the instance of the Indian Institute of Petroleum, Dehra Dun, a temperature controller unit suitable for studying polymerization reactions has been developed.

An electrical thermometer (range 0-600°C; full scale sensitivity, 100 mV/V input at a load resistance of 1000 Ω; and accuracy, ± 2°C) has been constructed using platinum as the thermal element. At the instance of the Himachal Pradesh Government, a forest cruiser suitable for surveying forest areas in hilly regions has been developed. Under a project sponsored by the Tata Institute of Fundamental Research, Bombay, the development of a flat glass plate assembly was completed successfully and a number of sets fabricated.

At the instance of the Physics Department, Panjab University, Chandigarh, a bubble chamber scanner has been developed. The instrument is a triple projector with three identical film feeding units. The negatives are projected on to a horizontal white screen at 10 × magnification, giving track images two-thirds the original size in the bubble chamber. The projection is designed for 70 mm × 90 mm film format and is well corrected for distortion, yielding a crisp image. Apart from its utility in the scanning of bubble chamber photographs, the instrument is useful in the experimental study of subatomic decays and interactions.

A polarizing microscope for studying crystals and rock specimens has also been developed. Production technology of certain infrared instruments has been developed for utilization by Defence Departments.

Commercial production of precision microscopes and projection optics, based on the know-how provided by CSIO, has been established by two firms.

Eleven processes for the manufacture of instruments/components were released to industry. Five patent applications were filed, one each in respect of (1) light transmitting materials for fibre optics, (2) automatic temperature controller, (3) gas supply failure alarm device, (4) foetal heart rate monitor, and (5) photo-electronic demodulator.

PROCESSES & PRODUCTS READY FOR COMMERCIAL UTILIZATION

Membrane Filter-B

Membrane filters are used in bacteriological analysis of water and waste water. These filters are imported under various trade names, involving considerable amount of foreign exchange. The estimated demand for the filters is about one million pieces/annum in India. The filters have a good export potential also.

The process for the preparation of membrane filters (Indian Pat. 129055) has been worked out on a laboratory scale by the Central Public Health Engineering Research Institute (CPHERI), Nagpur, and about 100 pieces were batch-produced to meet the immediate demand in the laboratory and other research organizations. To meet the orders on hand the rate of production is being stepped up.

Bleaching powder, sulphuric acid, absolute alcohol, glycerol, methyl acetate, *n*-butyl alcohol, cotton and tracing sheets are the main raw materials required.

The equipment required for the production of membrane filters include (i) cellulose preparation unit (digester, washer, bleaching unit, and hot air oven); (ii) nitration unit (glass-lined reaction vessel with stirring device, rapid washer, stainless steel vessel and oven); (iii) jelly preparation unit (stainless steel vessel, vacuum filtration unit and freezer); and (iv) membrane preparation unit (air-tight air-conditioned room, jelly spreading planes, membrane drying oven, membrane cutting unit and packing unit).

The capital investment for a unit capable of producing one million filters annually is about Rs 2 lakhs. The running cost per annum would be about Rs 2·5 lakhs, and the cost of production comes to about 22 P per membrane.

Further particulars may be obtained from: The Managing Director, National Research Development Corporation of India, 61 Ring Koad, Lajpat Nagar III, New Delhi 24.

Emulsion Paints from Styrenated Drying Oil

A process for the manufacture of emulsion paints from styrenated drying oil has been developed by the Regional Research Laboratory (RRL), Hyderabad. The process consists of the following steps: styrenation of drying oil; preparation of emulsion vehicle; preparation of pigment paste; and preparation of paint.

Drying oil is styrenated in a suitable reaction vessel and the product is cooled and discharged.

The styrenated drying oil after suitable dilution is mixed with an emulsifier and a drier to obtain the oil phase. The water phase is similarly prepared by mixing an emulsifier, a stabilizer and an antifoaming agent in a suitable quantity of water. The water and oil phases are emulsified by stirring together at high speed.

The pigment paste is prepared by grinding the pigment with suitable extenders, dispersing agents and water in a grinding mill to the desired Hegmann gauge.

Suitable amounts of emulsion and pigment pastes are mixed together to get a paint of required consistency.

The process has been studied on a pilot plant (capacity, 20 kg/batch) which was run for a year.

Dehydrated castor oil, styrene, solvents, emulsifiers, stabilizer, borax, liquor ammonia, pine oil, titanium dioxide, china clay, bentonite, sodium pyrophosphate, thickener and dispersing agents are the main raw materials needed for the process. All are available indigenously.

Styrenation kettle, mixers, emulsifiers, grinding mill and storage tanks are the essential items of plant and machinery. All these can be fabricated indigenously.

The total capital outlay for a plant capable of producing 150 tonnes of the paints per annum has been estimated at Rs 4·93 lakhs.

Parties interested in the commercial development of the process may correspond with: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

CSIR SUPPORT TO RESEARCH

Completed Schemes

Polymeric Semiconductors and Theoretical Analysis of Molecular Vibrations

Metal chelate complexes with polydentate ligands, in which one molecule of the ligand can bind at least two of the metal atoms, are known for a long time. Some of them have been shown to be semiconductors. It has also been recognized that extended conjugation, with the help of the coordinated metal atoms, makes the compounds semiconducting. A new polymeric silver complex of ethylene trithiocarbonate has been prepared and tested for its semiconducting properties by Dr P. Bhaskara Rao, a CSIR research fellow (presently at the Cement Research Institute of India, New Delhi), in association with Dr U. C. Agarwala, at the Chemistry Department, Indian Institute of Technology, Kanpur. An initial yellow silver compound with ethylene trithiocarbonate is transformed under the action of light into a semiconducting polymer.

A theoretical study of the molecular vibrational analysis followed by a detailed experimental study of the vibrational spectra of some inorganic complexes has also been carried out. Anomalies in the understanding of the vibrational spectrum of tetramethylammonium bis (maleonitrile dithiolato) Ni(II) have been clarified. Using a high-speed digital computer, the potential-field interactions in the molecule have been evaluated. Similar calculations have led to the understanding of the infrared spectrum of the caesium salt of bis (N-cyanodithiocarbimato) Ni(II).

Conformations of Aldopyranoses and their Derivatives

Conformation of monosaccharides is of utmost importance not only to understand their physical and chemical properties but also to work out the preferred conformation of polysaccharides since the former are the building blocks of the latter. These simple sugars exist in solution either in single conformation or in conformational equilibria depending on the energy difference between the various possible ring forms. The favoured conformations and the percentage composition of the equilibrium mixtures can be predicted theoretically from energy calculations. Hence the preferred conformations of aldopyranoses and some of their derivatives, viz. methyl glycosides and acetylated sugars in solution, have been investigated by computing the conformational energies using appropriate potential functions for various types of interactions. The investigations were carried out by Miss K. S. Vijayalakshmi, a CSIR research fellow, who worked at the Department of Chemistry, University of Madras,

Madras from October 1968 to October 1971.

In order to take into account the coulombic interactions in monopole approximation, a knowledge of the electronic charge distribution in the molecule is required. Since aldopyranoses and methyl glycosides are saturated σ-systems, the σ-charges in these molecules have been computed by the MO-LCAO method of Del Re. In the case of sugar acetates, the π-charges due to the mobile electrons at the conjugated parts (acetate groups) and the σ-charges in the saturated single bond framework have been evaluated separately. For the evaluation of π-charges, Hückel MO-LCAO method was employed. The charges thus obtained were used to compute the electrostatic energy.

Few attempts have been made to determine the conformational energies of aldopyranoses theoretically, but the results obtained have been found to disagree with experimental results, as ideal models alone were considered. Hence in the present study the potential energies of these molecules have been computed for the ideal and distorted forms in C1(D) and 1C(D) conformations. Minimization of the energies of these conformations has been studied by suitably tilting the axially oriented substituents by increasing the exocyclic bond angles at the ring carbon atoms. Considerable release of strain is achieved when tilts of about 3° and 4·5° respectively are given for the axial —OH and axial —CH_2OH groups involved in Hassel-Ottar effect and a tilt of about 2° for syn-axial —OH groups. The calculated free energy values, after adding a value of 0·4 kcal mole^{-1}, for the anomeric effect explained the favoured conformations assigned from nmr studies. The present data also indicate that all the aldohexopyranoses except α-D-altrose and α-D-idose exist only in C1(D) conformation, whereas all the aldopentopyranoses except α-D- and β-D-xylose exist in C1(D), 1C(D) equilibrium in solution.

Although considerable experimental data are available in the literature on the preferred conformation of methyl glycosides, no attempt has been made so far to investigate this problem theoretically. Hence the preferred conformations of these molecules have also been studied by giving appropriate tilts at axially oriented groups, as in the case of free sugars. The magnitudes of the deviations in bond angles in the minimum energy conformations are about the same as those observed in free sugars. The comparison of the favoured conformations assigned from these calculated energy values with experimental data reveals that the anomeric effect of —OCH_3 group is about 0·5 kcal mole^{-1}, which is much less than the value (1.2-1.4 kcal mole^{-1}) assigned by earlier workers. These results also predict that all of the methyl aldohexopyranosides excepting methyl-α-D- and methyl-β-D-idopyranosides prefer the C1(D) conformation. On the other hand, for the eight methyl aldopentopyranosides investigated, the energy calculations favour C1(D) conformation for methyl-α and β-D-xylopyranosides and methyl α-D-riboranosides. In other pentopyranosides, considerable amounts of both forms may be present in the equilibrium mixture. The α-anomer is found to be the more favoured in most cases. The studies also suggest that the favoured conformation of the pyranose ring is influenced by the addition of methyl group at C-1 atom in the case of α-D-altrose and β-D-idose only.

In spite of considerable information being available on the favoured conformation of sugar acetates in solution, no attempt has so far been made to determine their conformational energies theoretically. The sugar acetates have also been investigated. In C1(D) conformations of these molecules, the total energy is found to increase when syn-axially oriented groups are moved away, suggesting forces of attractive type between acetate groups. In 1C(D) conformations when a molecule is involved in Hassel-Ottar effect the bond angles deviate by 4.5° and 2° respectively at the ring carbon atoms to which axial —CH_2OAc and axial —OAc groups are attached. The favoured conformations predicted from the calculated free energy values correlate well with experimental results when a value of 0.7 kcal mole^{-1} has been added for the anomeric effect. The energy calculations predict C1(D) conformation as the favoured one for α-D-idopyranose pentaacetate and α-D-altropyranose pentaacetate and C1(D) $\rightleftharpoons$ 1C(D) equilibrium for β-D-idopyranose pentaacetate, suggesting that the stability of the pyranose ring may be influenced by the nature of the substituents. The calculated free energy differences for C1(D) $\rightleftharpoons$ 1C(D) equilibrium of aldopentopyranose tetraacetates agree fairly well with the experimental values obtained from nmr studies.

Free energy calculations have also been extended to cyclitols which are model compounds for sugars. These studies reveal that in the minimum energy conformations the axially oriented —OH groups are tilted by about 1° from the normal position as has been observed in the solid state also. The calculated free energy values are in good agreement with experimental values.

The investigations have given valuable information regarding the preferred conformations and the percentage composition in equilibrium mixtures of aldopyranoses and their derivatives; possible distortion in these molecules in different steric arrangements; anomeric effect of various groups; and the influence of the substituents on the stability of the pyranose ring.

PATENTS ACCEPTED

Indian Pat. 125137

Process for the production of protein concentrate from petroleum hydrocarbon fermentation broth

S. P. Srivastava, H. D. Singh, J. N. Baruah, P. V. Krishna & M. S. Iyengar
RRL Jorhat

The conventional processes for the separation of protein concentrate from petroleum hydrocarbon fermentation broth involve the use of ultrahigh centrifuge and the combination of polar and non-polar solvent. These processes increase the production cost considerably.

In the process covered by the patent use is made of certain indigenous surface active compounds as de-emulsifying agents. The use of surface active compounds at fixed *p*H and temperature removes major quantities of oil present in the broth. The separated protein cells are purified by treatment with relatively smaller quantities of solvent, followed by vacuum filtration and drying of the solution to obtain a white powdered protein concentrate.

Indian Pat. 127059

Improvements in or relating to the electrolytic reduction of nitroguanidine to aminoguanidine

T.D. Balakrishnan, K.S. Udupa, G.S. Subramanian & H.V.K. Udupa
CECRI, Karaikudi

Aminoguanidine and its salts are valuable intermediates for the synthesis of heterocyclic compounds which are largely used in the drugs and pharmaceutical industry. Aminoguanidine is also used in the synthesis of weedicides and explosives; the most important compound in this regard is 3-amino-1,2,4-triazole which has a great demand as weedicide in cotton plantations. To a limited extent aminoguanidine sulphate is used in the synthesis of tetrazene derivatives which are potential explosives. Aminoguanidine bicarbonate is also used in the synthesis of anti-foggants used for making quality films.

The demand for aminoguanidine bicarbonate required for the synthesis of aminotriazole alone is of the order of 200 tonnes/annum. There is no indigenous production of this chemical.

The process covered by the patent stipulates the condititions for the electrolytic reduction of nitroguanidine to aminoguanidine. The process consists in reducing a suspension of nitroguanidine in a supporting electrolyte of ammonium sulphate, preferably of 30% concentration. The reduction is carried out in a divided cell having a microporous rubber diaphragm supported on terylene cloth on both sides. The anolyte is 20% sulphuric acid, and lead is used as anode material. The cathode is a rotating mild steel rod or pipe having a deposit of zinc up to a thickness of 10 thou, the deposit having been obtained keeping the cathode rotating in an alkaline zincate bath. Nitroguanidine (50 g/l of catholyte) is added at regular intervals depending upon the current. By the addition of nitroguanidine in instalments the dissolution of zinc from the cathode is minimized and the same cathode can be used a number of times without requiring further deposition. Reduction is carried out at current densities up to 20 amp/dm^2 but preferably at 15 amp/dm^2. A total amount of 6F/mol of nitroguanidine is passed. During the course of reduction the *p*H of the catholyte is maintained between 8 and 9; the solution becomes clear as the reduction proceeds. The temperature of the catholyte is maintained below 20°C to avoid undesirable side reactions.

After the completion of electrolysis, the catholyte is filtered and treated with carbon dioxide to reduce *p*H to 8. Ammonium bicarbonate (70 g/l) is added and the solution is allowed to remain overnight. Aminoguanidine bicarbonate is filtered and the electrolyte is recycled for further use.

PATENTS FILED

134020 : A process for making, from commercial black cutch, a substitute for the imported vegetable tanstuffs like wattle and quebrache extracts, J. G. Srivastava—NBG, Lucknow.

134021 : An improved chemical process for easy and quick separation of coir fibres from coconut husk, J. G. Srivastava—NBG, Lucknow.

134121 : Improvements in or relating to methods of plating on aluminium, B. A. Shenoi—CECRI Karaikudi.

134122 : A simple easy and economic process for recovering sucrose from sugar factory molasses, J. G. Srivastava—NBG, Lucknow.

134156: Manufacture of bromine from bitterns (mother liquor left after the recovery of salt), P.K. Dutt, S.D. Gomkale, R.M. Kava, H.N. Shah & D.J. Mehta—CSMCRI, Bhavnagar.

134186: Improvements in or relating to methods of electrodeless copper plating over ABS plastics suitable for preparing printed plates, B.A. Shenoi & M. Ponnuthurai—CECRI, Karaikudi.

134264: Multipurpose portable plant cutter, C.L. Garg—MERDO, Ludhiana (CMERI, Durgpur).

134265: A strain gauge load cell, V.R. Singh & R. Parshad—NPL, New Delhi.

PATENTS SEALED

118515 : Improvements in rotary-lobe type blowers, pumps or expanders, R. Ramachandra, S. Natarajan & K. M. Chandrasekharan—CMERI, Durgapur.

118518 : A new coating composition for carbon paper production, C. N. Saikia, B. P. Chaliha, S. B. Lodh & M. S. Iyengar—RRL, Jorhat.

118570 : A brick extrusion machine, S. S. Wadhwa, N. C. Majumdar, L. K. Srivastava & E. S. H. Lal—CBRI, Roorkee.

118674 : Improvements in or relating to the preparation of concrete additives for increasing compressive strength and workability, G. P. Sastry, A. C. Khazanchi & M. S. Iyengar—RRL, Jorhat.

118744 : Refrigerated vessels for maintaining biological tissues and cultures for minimum of 24 hr and maximum up to 48 hr period for continental and intercontinental despatches, M. V. Bopardikar & V. R. Bhave—CPHERI, Nagpur.

FORM IV

(See Rule 8)

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Shanti Swarup Bhatnagar Memorial Awards for 1968 & 1969

Ten scientists have been named for Shanti Swarup Bhatnagar Memorial Awards for the years 1968 and 1969.

The recipients of the awards for the years 1968 and 1969 in the various subjects are as follows :

Physical Sciences : Dr A. P. Mitra, Scientist, National Physical Laboratory, New Delhi (1968); Dr A. N. Mitra, Professor of Physics, Delhi University, Delhi (1969).

Chemical Sciences : Prof. C. N. R. Rao, Head, Department of Chemistry, Indian Institute of Technology, Kanpur (1968); Prof. A. C. Jain, Head, Department of Chemistry, University of Jammu, Jammu (1969).

Biological Sciences : Dr T. A. Venkitasubramanian, Head, Department of Biochemistry, Vallabhbhai Patel Chest Institute, Delhi University, Delhi (1968).

Engineering Sciences : Dr K. R. Chakravorty, Director, Fertilizer Corporation of India, P & D Division, Sindri (1968).

Medical Sciences : Dr U. K. Sheth, Professor & Head, Department of Pharmacology, Seth G. S. Medical College & K.E.M. Hospital, Bombay and Dr S. R. Mukherjee, Professor-in-charge, Department of Experimental Medical Sciences, Institute of Post-Graduate Medical Education and Research, Calcutta (1968); Prof. S. Kalyanaraman, Professor of Neurosurgery, Madras Medical College, Madras and Prof. Ranjit Roy Chaudhury, Director, Post-Graduate Institute of Medical Education and Research, Chandigarh (1969).

Process for Lysine Production: CDRI

Lysine is an important essential amino acid and is used mainly as a diet supplement in cases of protein deficiency. It is known to help better utilization of available food materials. Lysine is being used in the country for the fortification of bread and flour. It is also a constituent of vitamin preparations. The entire requirements of the country are met by import.

In this context, the development of a process for the production of lysine based on indigenous raw materials was taken up by the Central Drug Research Institute (CDRI), Lucknow. It is known that homoserine and threonine-deficient auxotrophs of glutamic acid-producing bacteria are capable of producing large amounts of lysine. Starting with a wild strain of *Micrococcus glutamicus* which did not produce any measurable amount of lysine, attempts were made to mutate the strain by ultraviolet irradiation and chemical mutagens like nitrosoguanidine. An auxotroph has been developed through ultraviolet irradiation, which is capable of yielding 20 g of lysine/litre (estimated as hydrochloride) when grown in a simple medium. The constituents of the medium are easily available materials like sugar (commercial), corn steep liquor, urea and some inorganic salts. Lysine (98% purity) is isolated from the fermentation medium by ion-exchange chromatography on Amberlite IRC-50, as the hydrochloride, with 80% recovery. The fermentation step has been standardized on shake flask scale. The process will be scaled up progressively in a 100-litre fermentor, and finally in a 3000-litre fermentor to work out the economic feasibility of the process.

Attempts are also being made to obtain an improved strain of *M. glutamicus* which would give higher yields of lysine. Commercial yields of the amino acid are reported to vary from 4 to 50 g/litre. In Japan, which is the most important producer of lysine in the world, the best yield is claimed to be 56 g/litre.

The same strain of *M. glutamicus* was found to yield glutamic acid as the main product when grown in high concentrations of molasses and cornsteep liquor. Glutamic acid is used as a flavouring agent for food, particularly meat.

ATIRA's Permanent Press Process for UAR

The process for imparting Permanent Press finish to cotton-polyester blend fabrics, developed by the Ahmedabad Textile Industry's Research Association (ATIRA), Ahmedabad, has been licensed to UAR. Under an agreement entered into by ATIRA and the General Organization for Executing the 5-Year Industrial Plan (UAR), ATIRA will provide technical know-how for the process including quality control procedures and training facilities to UAR technicians, and will send its specialists to UAR for starting production. UAR will pay ATIRA a fee of £ 10 000 sterling for the process.

The Permanent Press process is based on the use of mixed catalysts which greatly accelerate the reaction of the cross-linking reagents employed for the finishing. As a result, the conditions required for fabric finishing as well as for the manufacture of Permanent Press garments are less drastic than those employed in conventional processes. For example, the need for garment curing ovens is entirely eliminated. The milder conditions employed in the ATIRA process also offer advantages such as wider choice of dyestuffs, better feel of finished garments, and less rigorous process control. These features of the ATIRA process make it particularly suitable for small and medium scale garment manufacturers.

The process has been in regular commercial use by its two exclusive licensees in India, viz. Bombay Dyeing & Mfg Co. Ltd, Bombay, and Sarangpur Cotton Mfg Co. Ltd, Ahmedabad.

A process for imparting permanent press characteristics to pure cotton fabrics is being developed by the Association.

Republic Day Honours

Prof. B. D. Tilak, Director, National Chemical Laboratory, Poona and Prof. R. N. Chakravarti, Director, Indian Institute of Experimental Medicine, Calcutta are among the recipients of Padma Bhushan for the year 1972. Dr A. B. Kar, Deputy Director, Central Drug Research Institute, Lucknow, is among Padma Shree awardees. Brief biodata of Prof. Tilak and Prof. Chakravarti, and their contributions to science and technology follow.

Prof. B. D. Tilak

Prof. Bal Dattatraya Tilak (born 26 Sept. 1918) had a brilliant academic career at the Bombay University. He graduated in chemistry (1937) and chemical technology (1939) at the Bombay University Department of Chemical Technology (BUDCT). Working under the guidance of Prof. K. Venkataraman, he obtained the Ph.D. degree (1943) in textile chemistry. Thereafter he took the D.Phil. degree (1946) in organic chemistry at the Oxford University where he carried out research under the guidance of Sir Robert Robinson.

Returning to India in 1946 Dr Tilak joined BUDCT where he established an active school of research in dyestuff chemistry and technology as Professor of Dyestuff Technology (1950-1965). During 1960-61 Dr Tilak spent a sabbatical year at the Harvard University to carry out research in association with Prof. R. B. Woodward on the chemistry of phosphorins, phorin salts and chlorophyll.

At BUDCT, Dr Tilak made significant contributions to dyestuff chemistry and technology. The growth of dyestuff and several organic chemical industries in the country is in no small measure due to the efforts of Dr Tilak.

Dr Tilak also carried out pioneering research on the chemistry of heterocyclic compounds, especially those containing five- and six-membered sulphur, nitrogen and oxygen ring systems. This work involving the development of several new and general methods of synthesis has led to the synthesis of new heterocyclic systems, heterocyclic steroids, carcinogenic polycyclic thiophenes and potential anticancer agents. Among the several honours and awards received by Dr Tilak mention may be made of K. G. Naik Gold Medal of the M. S. University of Baroda in 1959 for his contributions to industrial research, the Basudev Banerjee Medal and Prize of the Indian Chemical Society for contributions to basic organic chemistry in 1959-60, and the Shanti Swarup Bhatnagar Memorial Award for chemical sciences in 1963. He was also awarded the D.Sc. degree of the Oxford University in 1961. Dr Tilak is a Fellow of the Indian National Science Academy and of the Indian Academy of Sciences (Bangalore).

Appointed Joint Director of the National Chemical Laboratory in 1965, Dr Tilak took over as Director in 1966. Under his leadership, the laboratory has made pioneering contributions to the chemical industry and also to the advancement of chemical research. Suffice it to say that the annual turnover of products based on NCL know-how has increased to more than Rs 2·5 crores in 1970-71 from Rs 22 lakhs in 1966-67.

Dr Tilak has been guiding basic and applied research in heterocyclic compounds and new quinonoid chromophoric systems and dyes. He has more than 150 research publications to his credit. Dr Tilak has visited several R & D laboratories, universities and industries in Europe, USA and Japan. He led the Indian scientific delegation to Rumania in 1971 and was a member of the Indian scientific delegation to UAR in 1968 and the American Chemical Society's diamond jubilee in 1950-51.

He is a member of the Development Council of Organic Industries, and chairman of the Standing Committee on the development of dyestuff industries and the Panel on organic chemical industries in the small scale sector. He has been a consultant to chemical industries for the past 17 years. He is on the Board of Directors of the Indian Petrochemicals Corporation Ltd and the Hindustan Antibiotics Ltd; he is also chairman of the Board of Directors of Hindustan Organic Chemicals Ltd, Rasayani.

Dr Tilak was appointed a member of the National Committee on Science and Technology (NCST) in 1971 and is currently entrusted with the task of formulating Science and Technology Plan for the Chemical Industry as the convener of NCST Panel on Chemical Industries.

Prof. R. N. Chakravarti

Prof. Ram Narayan Chakravarti (born 1 August 1916; Rewa, Madhya Pradesh) was educated in Calcutta. After a brilliant academic career in the course of which he won several scholarships, medals and prizes, he took the D.Sc. of the Calcutta University in 1945. Joining the Dyson Perrins Laboratory of the Oxford University he worked with Sir Robert Robinson and made valuable contributions to the final elucidation of the structure of strychnine during 1945-47. Dr Chakravarti carried out a partial synthesis of alpha-spinasterol and improved the synthesis of vitamin D_3 in collaboration with Prof. L. F. Fieser at the Converse Memorial Laboratory, Harvard University, during 1947-48. In 1958 he made important contributions with Prof. N. P. Bun-Hoi in the synthesis of complex, biologically active coumarins at the Institut du Radium, Paris.

From 1948 to 1968, Dr Chakravarti was Professor of Chemistry at the Calcutta School of Tropical

Medicine where he was also the Deputy Director for a number of years. Here he worked mainly on the chemistry of medicinal plants, and made significant contributions to the chemistry of natural steroids, a field in which he has pioneered research in India. He discovered two rich sources of diosgenin, namely *Dioscorea deltoidea* of Kashmir, Punjab and Himachal Pradesh, and *D. prazeri* of Darjeeling area as far back as 1952, and emphasized the importance of these as starting materials for the production of steroid hormones. This work provided the base for the establishment of the Indian steroid industry.

Other valuable contributions made by Prof. Chakravarti relate to the isolation, structure elucidation and synthesis of terpenoids and alkaloids, and the effect of substituents on the course of cyclization reactions. The test for the detection of argemone adulteration of edible oils, developed by him, is not only the most sensitive laboratory test but is also of considerable use in the study and control of epidemic dropsy. During the outbreak of the mysterious paralytic disease in the Malda (West Bengal) and the Darrang area in Assam in 1962, he identified as tricresyl phosphate the toxic agent present in imported wheat flour (maida) by both chemical and biological tests.

Prof. Chakravarti joined the Indian Institute of Experimental Medicine as Director in September 1968. He has not only expanded and intensified the institute's research activities in all its divisions but planned new its divisions for biophysics and biochemical engineering.

As Honorary Secretary of the Institution of Chemists (India) since 1951, he started the A.I.C. examination in applied analytical chemistry the very first year.

Prof. Chakravarti is the recipient of P.R.S. and Mouat Medal of the Calcutta University, K. G. Naik Medal of the M. S. University of Baroda, Elliot Prize of the Asiatic Society, Cooper Medal of the Institution of Chemists (India), and J. M. Dasgupta Medal and Acharya P. C. Ray Medal of the Indian Chemical Society. He has been awarded the Sisir Kumar Mitra Memorial Lectureship of the Indian National Science Academy for 1972. He has been a Fellow of the Royal Institute of Chemistry since 1948 and of the Indian National Science Academy since 1956.

Dr A. B. Kar

An account of Dr Kar's contributions to research in the field of mammalian reproduction, and biomedical aspects of contraception and family planning has been published recently in *CSIR News* [**21** (1971), 99]. Dr Kar is presently at Geneva under a WHO assignment to assist in the implementation of the expanded programme of research, development and research training in human reproduction.

Dusty Occupation and Lung Diseases

The dusty occupation of coal miners in relation to lung diseases has been investigated by Dr S. H. Clerk of the Central Mining Research Station, Dhanbad. The study was conducted both in a mechanized and a non-mechanized coalmine, and 15% of the total workers of the mechanized mine and 40% of the non-mechanized mine were considered keeping in view all the eight categories of workers of the mine, viz. miners, drillers, loaders, trammers, mining staff, craftsmen, *mazdoors* and clerical staff.

The study has revealed certain important data in respect of the lung diseases due to the dusty occupation of coal miners. The age at which the diseases appear, the categories of workers affected, and the total duration of dust exposure at which the diseases are seen in workers both in the mechanized and non-mechanized mine were studied in detail. The studies were conducted by taking case histories of workers followed by chemical examination and X-ray of heart. Pneumoconiosis, tuberculosis, tropical eosinophilia and bronchitis were the lung diseases detected.

With regard to pneumoconiosis, 4% cases in the non-mechanized mine and 5·2% cases in the mechanized mine were detected; less advanced categories of the disease were detected in the former mine. In the mechanized mine, pneumoconiosis cases appeared in the age group 30-34 years—a 5-year earlier age group compared to the age group of workers afflicted with this disease in the non-mechanized mine. The mean age of pneumoconiosis cases was 48·7 years in the case of the non-mechanized, and 46·8 years in the case of the mechanized mine. Pneumoconiosis appeared 5 years earlier in the mechanized mine at 11-15 years' duration of dust exposure. Advanced categories were observed in the age group 21-25 in the mechanized mine, whereas less advanced categories were observed in the non-mechanized mine at 26-30 years' duration of dust exposure. Miners were the worst affected group in both the mines as far as the advanced categories of the diseases are concerned.

There were 6% cases of tuberculosis in the non-mechanized mine and 3·9% cases in the mechanized mine. Cases appeared 5 years earlier (20-24 years age group) in the mechanized mine compared to the cases in the non-mechanized mine. With regard to the duration of the dust exposure also, the cases appeared earlier by 5 years in 0-5 years' duration.

Tropical eosinophilia was found in 8% of workers in the non-mechanized mine and in 7·8% of workers in the mechanized mine. Within 10 years of dust exposure, 78·1% of the workers contacted the disease; miners and *mazdoors* constituted the bulk of the affected.

Bronchitis appeared in 6% of workers in the non-mechanized mine and in 7·2% of workers in the mechanized mine. In the mechanized mine, cases appeared earlier by 5 years (25-29 years age group) than in the non-mechanized mine. Similarly, cases appeared earlier in the mechanized mine by 5 years at a dust exposure below 5 years. Miners and loaders were the most affected in the non-mechanized mine, but in the mechanized mine only the latter were affected most.

The thesis relating to the studies formed part of the requirement of the M. D. degree (Social and Preventive Medicine) awarded to Dr Clerk by the Kanpur University, Kanpur.

Symposium on Pressure Vessel Technology

A symposium on Pressure Vessel Technology, jointly sponsored by the Central Mechanical Engineering Research Institute (CMERI), Durgapur, the Indian Standards Institution, New Delhi, and the Fertilizers and Chemicals of Travancore Ltd, Udyogamandal, was held at Cochin from 15 to 17 November 1971. More than 150 delegates from pressure vessel manufacturing and user industries, educational and research institutes, and design and standards organizations participated in the symposium which served as a forum for the exchange of ideas on the design, manufacture, inspection and research in pressure vessel technology.

Twenty-four papers were presented and discussed. Some of the topics dealt with included : manufacturing techniques and problems of high pressure coils for pressure vessels ; fabrication of Horton sphere ; modern codes and trends in the design and development of pressure vessels for petrochemical industries ; welding of aluminium pressure vessels by manual tungsten inert gas process ; fabrication of heavy pressure vessels ; design of pressure vessels against brittle fracture ; computer design of optimum vessel flanges ; design of high pressure cylinders for cyclic pressures using autofrettage technique ; differential expansion in process equipment ; and compound vessels.

Three papers were presented by CMERI scientists. One of the papers (K. Das, now with EIL, Delhi) discussed the design procedure usually adopted for multilayer vessels and the use of a digital computer for simplifying the design. The second paper by B. M. Sen and others dealt with compound vessels. Compound vessels enable higher pressures to be contained and better utilization of material. They are especially useful where the inner core has to be made of an expensive corrosion-resistant material and the outer layers are made of relatively cheap material. The third paper, presented by B. M. Sen, dealt with the strip-wound fabrication of multilayer vessels. This method consists of wrapping a core cylinder with strips of steel under tension until the desired wall thickness is built up. A specially designed lathe is used for wrapping, which has provisions to raise the temperature of the strip and for cooling after wrapping. Participants evinced interest in this work conducted at CMERI, and the paper was followed by a discussion on the usefulness of this technique.

There was considerable discussion on the code relating to the unified pressure vessels, brought out recently by the Indian Standards Institution. The code covers the minimum requirements for the design, fabrication, inspection, testing, and certification of fusion-welded pressure vessels in ferrous and non-ferrous metals. Measures for implementing the code by the pressure vessel industry in India were also discussed.

In the concluding session the participants expressed their views on the role of research in the field of pressure vessels, the need for collaboration among the research organizations, educational institutions and the industries, and the usefulness of symposia as media for transfer of ideas. It was recommended that priorities in research and developmental efforts should be decided in relation to their importance to industry. A suggestion was also made that national laboratories and research institutions should take up work sponsored by industries.

PROGRESS REPORTS

CFRI Annual Report: 1969-70

The Central Fuel Research Institute (CFRI), Dhanbad has brought out its annual report for 1969-70. The progress in research and development activities of the institute is set out in the following 14 major areas: Natural solid fuels—sources and properties; Natural solid fuels—preparation; Carbonization; Manufacture of solid fuels; Industrial carbons and carbon products; Combustion, industrial furnace and kilns; Gasification and gaseous fuels; Chemicals from byproducts of carbonization and gasification; Synthetic liquid fuels; Agro-biological applications of coal and its derivatives; Fundamental studies relating to fuel technology; Analysis, testing and instruments; Operations research; and Miscellaneous projects. Twenty-four projects were sponsored by industries.

A major effort of the institute was the commissioning of the high pressure catalytic vapour phase hydrogenation pilot plant. This facility will be used for studying the commercial feasibility of various hydrogenation processes developed by CFRI for producing middle distillates from coal or petroleum feedstocks.

Hydrogenability of coals from Assam for the production of oil and chemicals has been studied on bench scale autoclaves. A cheap and efficient catalyst for the hydrogenation of coal has been developed by the institute. A feasibility report on the conversion of coal to oil by hydrogenation was prepared on the basis of the studies.

Work on the production of formed coke from non-coking coals was continued. A 0·5-tonne/hr formed coke batch pilot plant was run, and 50 tonnes of finished carbonized briquettes were produced for undertaking low shaft furnace trials at the National Metallurgical Laboratory, Jamshedpur. Tests were carried out with Kutkona coals in prototype vertical retorts for low/medium temperature carbonization and in the pilot plant for formed coke production after preparing the char by fluid-bed carbonization of slacks. A feasibility report was prepared on the utilization of Kutkona coal on behalf of Audyogik Vikas Nigam Ltd, Madhya Pradesh. At the instance of Industrial Development Corporation of Orissa Ltd, a feasibility study for producing pig iron in low shaft furnace, using formed coke made from Talcher coal, was undertaken in collaboration with the Chemical & Metallurgical Design Co, New Delhi.

A contract was signed with a chemical engineering consultant firm for commercialization of the processes for the production of cyanopyridines from picolines, and benzoic acid and benzaldehyde from toluene.

A 5-tonne/hr pneumatic separator was erected for the selective preparation of coal. An oleo-flotation process has been developed for simultaneous upgrading and dewatering of small and fine coal. A testing plant (250 kg/hr) was installed and a number of trial runs were successfully conducted. The moisture content of the clean product could be reduced to 6-8%. An agreement for commercial development and utilization of the process was under negotiation with McNally Bird Engineering Ltd, USA.

Middlings and rejects produced in coking coal washeries treating crushed coal are of limited use owing to high ash content. A pelletization technique for producing sized and spherical smokeless domestic fuel from these byproducts has been developed. A 1-tonne/hr pan type pelletizer with mixer has been installed; large scale pelletization tests on the utilization of washery byproducts, low grade coals and slurries are in progress.

A process has been developed for the production of naphthalene from alkylnaphthalenes present in coal tar and petroleum fractions. A method for the isolation and separation of beta- and alpha-methylnaphthalenes from coal tar and petroleum fractions has been developed. Catalytic vapour phase oxidation of anthracene to anthraquinone (95% yield) has been carried out using a catalyst developed at the institute.

Based on the processes developed for the extraction of acids or phenols from coal tar oils, an extraction unit of capacity one tonne of tar oil per day has been designed, fabricated and installed.

Investigations on the utilization of fly ash, a byproduct of pulverized fuel fired power stations, have resulted in the development of two types of bricks (silicate bonded and chemically bonded bricks) which are superior to burnt bricks. A beneficiation scheme for the disposal of high ash fine coal from Bisrampur colliery (Madhya Pradesh) has been prepared.

At the instance of Pyrites, Phosphates & Chemicals Ltd, a scheme for upgrading the Amjor pyrites for increasing the sulphur content from 17-25% to 36% with 80% recovery was completed. A study was undertaken on behalf of Andrew Yule & Co. on the utilization pattern of the Borachak seam coal. A survey to assess resources available for the thermal power (500 MW) station at Santhaldih has been completed. Other consultancy projects investigated by CFRI include : fuel efficiency studies for Daurala Sugar Works (Meerut) and West Coast Paper Mills, Mysore State; feasibility studies for Monidih Washery Project of the National Coal Development Corporation Ltd; and measures for improving the overall performance of Kargali Washery.

Advice was rendered to the Ministry of Mines and Metals, and of Steel on the planning for coal supply for steel plants and washeries, and plans were prepared for the distribution of coking and blendable coals.

PROCESSES & PRODUCTS READY FOR COMMERCIAL UTILIZATION

Leather Boards from Leather Waste

Vegetable and chrome tanned leather shavings and trimmings could be converted to leather boards and profitably utilized in the manufacture of insoles, counters, etc. required by the footwear industry. Leather boards can also be used for making cheaper goods like cycle tool boxes and book covers. Chrome leather boards have better dimensional stability, better heat resistance in moulding, etc. than conventional leather boards.

The estimated annual demand for leather boards is 10 000 tonnes, which works out to 10 million boards (size 92 cm × 61 cm; weight about 1 kg each). The present indigenous production of leather boards is about 5000 tonnes/annum, and their manufacture is based on bark tanned trimmings.

Process

In view of the superior quality of board obtained from chrome tanned leather waste, the Central Leather Research Institute (CLRI), Madras has developed a process (Indian Pat. 122995) for producing leather boards from chrome tanned leather shavings and trimmings. The process can also be used for making boards from vegetable tanned leather shavings.

Leather scrap is subjected to dry grinding, and the ground scrap is mixed with the required chemicals and ingredients in a Hollander mixer. The mixture is wet ground in a Hollander beater, and the pulp is fed to the sheet forming unit to obtain leather sheet. The sheet is pressed, dried, calendered and trimmed to obtain boards of desired sizes. Dry grinding is required only when vegetable tanned trimmings and shavings are used as raw material.

The process has been successfully tested for six months on a 10-kg/day scale in the laboratory. The capacity for the minimum economic unit suggested by the institute is one tonne of leather boards (1000 boards, 2-2·5 mm thick and 92 cm × 61 cm size) per day.

The capital outlay for a plant to produce a tonne of leather boards per day has been estimated at Rs 6·75 lakhs, comprising Rs 1·00 lakh for land and building, Rs 2·75 lakhs for plant and machinery, and Rs 3·00 lakhs as working capital.

The main equipment required for producing leather boards are Hollander mixer and beater, sheet forming unit, hydraulic presses, calendering machines, drying chambers, buffing machine, pulp handling pump, water pump and cutting machines. A dry cutter will be needed in case vegetable tanned trimming are used as raw material.

On the basis of a production of 300 tonnes of board per annum (equivalent to 3 00 000 pieces of 92 cm × 61 cm boards) the cost of production is estimated at Rs 4·20 per board.

Parties interested in the commercial utilization of the process may correspond with: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

Egg Coating Oil

Eggs normally do not keep well for more than 5 to 6 days under tropical conditions such as high humidity and temperature, and this is a major problem faced by poultry farmers and retailers. About 20% of the eggs produced in the country do not reach the consumer in good condition. Cold storage facilities used in the advanced countries for preservation are beyond the means of Indian farmers and traders. Methods currently employed in the country for the preservation and packaging of eggs are not satisfactory, and especially during transit 5 to 10% spoilage occurs due to microbial infection. The internal quality of eggs also deteriorates under high humidity and temperature.

These defects are overcome by a simple technique, evolved by the Central Food Technological Research Institute, Mysore, of treating the eggs with a formulation based on a petroleum product and preservatives. The shell eggs treated with the formulation keep well for about 4 weeks at room temperature(75-78°F). The basket containing the eggs is taken out and hung on a hanger to drain off the oil. The oil is collected for reuse. The eggs after being dried are packed either in egg baskets or in fillerflats in cartons and are ready for despatch. The entire operation takes about 2 hr.

The equipment, which can be easily fabricated at a reasonable cost, consists of : (i) a vessel/drum fitted with an immersion heater connected to a simmerstat (or thermostat); (ii) a specially fabricated metal or wooden frame with an arrangement for handling basket, and fitted with a galvanized iron pan to collect the drained oil; and (iii) basket for holding the eggs.

The equipment designed at the institute is capable of treating 8000 to 10 000 eggs per day. A litre of oil is sufficient for treating 3000 eggs. The oil can be reused repeatedly by occasional filtration and sterilization. The cost of coating 100 eggs works out to about 20 paise and the equipment costs about Rs 1000.

Parties interested in undertaking the commercial exploitation of the process may correspond with: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

CSIR SUPPORT TO RESEARCH

Completed Schemes

Biochemical Mechanism in Genetics Diseases

Some of the molecular diseases have been studied in detail to understand the biochemical mechanisms involved in these genetics diseases. The porphyrias, among them, are characterized by the over-production and excretion of porphyrins and/or their precursors. The studies were made by Shri M. R. Satyanarayana Rao, a CSIR research fellow, who worked at the Department of Biochemistry, Indian Institute of Science, Bangalore (June 1969 to November 1971) under the guidance of Dr G. Padmanabhan of the Department. The basic defect has been found to be the enhanced levels of δ-aminolaevulate synthetase (ALA synthetase), the first and regulatory enzyme in the heme biosynthetic pathway. However, the differences in the accumulation pattern of porphyrins in various kinds of porphyria have not been explained. In the present studies, porphyrias were produced in experimental animals using such drugs as allyl isopropyl acetamide (AIA) and dicarbethoxy dihydrocollidine (DDC) to evaluate the causes for the different accumulation patterns, and the mechanism of induction of ALA synthetase by these drugs.

AIA has been found to cause accumulation of porphyrin precursors in livers of rats, which are excreted in the urine. DDC causes accumulation and excretion of porphyrins in mice. The difference in accumulation pattern has been traced to the greater efficiency of mouse liver to convert porphobilinogen (PBG) to porphyrins and inhibition of ferrochelatase by DDC, although induction of ALA synthetase is the primary reason.

ALA dehydratase is inhibited by coproporphyrinogen III when added *in vitro*, thus providing an additional regulatory mechanism of heme synthesis.

AIA causes depression of both hepatic catalase and microsomal cytochrome P450 levels. The effect on catalase has been shown to be mediated through over-production of heme, since administration of heme and bilirubin brings about a similar effect. Also, a block in ALA synthetase induction by cycloheximide or glucose or phenobarbital pretreatment releases the effect of AIA on catalase. However, depression of cytochrome P450 does not depend on ALA synthetase induction. But the induction of ALA synthetase partially depends on depression of cytochrome P450 levels. It is known that heme is the corepressor for ALA synthetase and a depletion of the heme pool caused by depression of cytochrome P450 would lead to ALA synthetase induction.

Particle-Core Coupling in Odd Nuclei with *N* or *Z*=29

A systematic investigation on six odd-mass spherical nuclei was made under a CSIR research scheme, using different types of model calculations with a view to assessing the relative merits of these models in this region. The investigation was made by Shri M. N. Sitaramanath, a CSIR research fellow, who worked at the Department of Nuclear Physics, Andhra University, Waltair. The models considered are the intermediate coupling model, the core-excitation model and the extended core-excitation model.

In the intermediate coupling model approach, an odd-mass spherical nucleus is considered to be a coupled system of a doubly-even core susceptible to quadrupole vibrations with frequencies of the neighbouring doubly-even nucleus, plus the last odd particle to which are available several single particle states. It is further assumed that the single-particle states of the odd particle are neither weakly nor strongly coupled to quadrupole vibrations of the doubly-even core. This model essentially implies a quadrupole interaction between the particle and the core.

In the core excitation model the coupling between the particle and core is assumed to be a scalar, which can be written as a sum of scalar products of tensors of rank *k*, and the interaction Hamiltonian is assumed to be similar to that used by Thankappan and True. This interaction implies a considerable dipole-dipole interaction in addition to the quadrupole-quadrupole interaction. But the work done in this

Department and elsewhere has indicated that the $k=3$ term also is important.

The above approaches have been used in the present study to interpret the level structure of ^{65}Cu, ^{63}Cu and ^{61}Cu; and ^{51}Ti, ^{53}Cr and ^{55}Fe. The former have 29 protons and the latter 29 neutrons. The $f_{7/2}$ shell is assumed to be closed at 28 so that the odd nucleon will have $p_{3/2}$, $p_{1/2}$ and $f_{5/2}$ orbitals available to it. The motion of the nucleon in these orbitals is coupled to the core vibrations. In the intermediate coupling approach, up to two phonons are included. In the core excitation models, up to one phonon only was included as in the earlier calculations.

The Hamiltonian matrices for each model are formed for the different angular momentum states and they are diagonalized on a CDC 3600 computer to yield the eigenvalues and eigenvectors. These eigenvectors are then used to predict the spectroscopic factors and electromagnetic properties.

The following conclusions were arrived at from the calculations on energy levels, transition rates and spectroscopic factors:

The intermediate coupling approach in the unified model gives a relatively poor description of nuclei with N or $Z = 29$, whereas the core-excitation models give a rather good description of the low lying spectra of the nuclei. This would imply that the quadrupole-quadrupole interaction between the particle and the core is inadequate to describe these nuclei, and $k = 1$ and $k = 3$ terms are important at least in the case of these nuclei.

Ion Association and Mixed Ligand Complexes of Vanadium and Iron

Studies on mixed ligand and ion association complexes of vanadium and iron and their analytical applications have been made by Shri P. V. R. Bhaskara Sarma, a CSIR research fellow, at the Department of Chemistry, Andhra University Post-graduate Centre, Guntur, under the direction of Prof. V. Pandu Ranga Rao.

The ligand systems chosen were *o*-phenanthroline-thiocyanate and *o*-phenanthroline-azide. Vanadium (IV) was found to form with *o*-phenanthroline and thiocyanate a yellow mixed ligand complex at about *p*H 2. The complex, insoluble in the aqueous phase, distributes into a number of organic solvents producing yellow extracts. Optimum conditions for the formation of the complex were established. The methyl isobutyl ketone (MIBK) extract of the complex was found to absorb in the wavelength region 367-374 nm; molar absorptivity of the complex is 1500. Vanadium was quantitatively extracted in the presence of these two ligands. With thiocyanate alone, vanadium (IV) under the experimental conditions employed was extracted to the extent of 30% and 69% with MIBK and *n*-butanol respectively, while with *o*-phenanthroline as the only ligand there was no extraction, indicating a synergic effect of the ligand system on the extraction of vanadium. The composition of the extracting species has been determined from absorption measurement and solvent extraction studies. The extracting species has been shown to be $[\mathrm{Vo\ (Phen)\ (NCS)_2\ \ (ROH)}]$, and based on this complex the mechanism of the synergic effect has been explained. The nature of the complex was further confirmed on the basis of infrared absorption spectrum and magnetic moment.

When solutions of vanadium(V), *o*-phenanthroline and azide were mixed at about *p*H 3, a pale yellow coloured complex was produced, which on extraction with organic solvents was found to give two different colours depending on the nature of the solvent. Solvents like benzene, chloroform and carbon tetrachloride gave an unstable blue-violet complex; alcohols and ketones gave a reddish yellow extract. The molar absorptivity of the complex in 25% *n*-butanol in benzene is 5166 at 455 nm. This is a more sensitive reaction that the vanadium(IV)-*o*-phenanthroline-thiocyanate reaction. Solvent extraction studies revealed that azide and *o*-phenanthroline individually did not form extractable species. However, with a mixture of these two ligands, vanadium was extracted to the extent of 80% with 25% *n*-butanol in benzene or pure *n*-butanol. The composition of the extracting species has been determined.

In the extraction-photometric determination of iron with *o*-phenanthroline, anions like perchlorate, iodide, cyanide had been used by earlier workers to obtain neutral extractable species. In all these methods, iron(III) was reduced initially to iron(II) with a reductant like hydroxylamine hydrochloride. The present study has shown that iron(III) is quantitatively reduced to iron(II) in the presence of *o*-phenanthroline by thiocyanate and an extractable violet complex is formed, which exhibits maximum absorbance in the region 520-530 nm and possesses a molar absorptivity of 20 450 in methyl isobutyl ketone. This is the highest value so far reported for the ferroin ion-association complexes employing colourless anions. The new method has been used for determining iron in commercial grade chemicals and alloys. The composition of the extracting species, determined by absorption measurements, has been found to be $[\mathrm{Fe(Phen)_3}]^{2+}\ 2(\mathrm{NCS})^-$.

Azide was also found to reduce iron(III) to iron(II) in the presence of *o*-phenanthroline. The composition of the extracting species has been found to be $\mathrm{Fe(Phen)_2\ (N_3)_2}$. This is a mixed complex, the azide ions entering the coordination sphere by replacing one *o*-phenanthroline molecule. The molar absorptivity of this complex is 16 500 (nitrobenzene). Though not as sensitive as the ferroin-thiocyanate reaction, the method is more selective.

Vigyan Pragati : Defence & Science Number

A special number of *Vigyan Pragati* devoted to Defence and Science, brought out by the Indian Languages Unit of CSIR, was released by Shri C. Subramaniam, Minister for Planning, Science & Technology, and Vice-President, CSIR, at a function held at the National Physical Laboratory, New Delhi on 2 March 1972. Releasing the publication, the Minister called for the creation of a scientific temper in the country for promoting science and for utilizing science for the solution of national problems. Emphasizing the importance of spreading scientific knowledge among the masses, Shri Subramaniam said that popular science magazines like *Vigyan*

Pragati have to play an important role in this regard. He called for concerted efforts on the part of CSIR in particular to the dissemination of science through publication in all Indian languages. He also emphasized that newspapers and magazines should provide more space for science and technology topics. The important role of the radio and films in the dissemination of science among the masses was also pointed out by him.

The special 144-page issue (January-February 1972) of *Vigyan Pragati* contains 38 articles of defence interest. The articles have been divided into five main sections: Army, Navy, Air Force, Role of Research Laboratories in Defence, and Miscellaneous section, besides a general section.

The general section includes an article by Dr Y. Nayudamma, Director General, Scientific & Industrial Research, on the role of national laboratories in national defence. The section on army includes articles on infantry, rifles, tanks, anti-tank weapons, anti-aircraft guns and mines. The section on navy contains articles on Indian warships, submarines, Pakistan naval strength, the role of electrical and electronic engineering in the navy, naval weapons, etc. The section on air force has articles on Indian and Pakistan war planes, parachutes, radar, devices to mislead radar, etc. besides a picture gallery of Chinese war planes. Articles on the Defence Research and Development Organization, the Central Glass & Ceramic Research Institute, Calcutta, the National Chemical Laboratory, Poona and the Central Leather Research Institute, Madras are included in the section relating to the role of research laboratories in defence. Biological and chemical weapons, explosives, hazards of nuclear war, etc. are some of the topics covered in the miscellaneous section.

Society of CLRI Associates

A new professional body under the name Society of CLRI Associates has been formed at the Central Leather Research Institute (CLRI), Madras; it was formally inaugurated on 31 January 1972. The chief objectives of the society are: (i) to promote scientific and social activities among the associates; (ii) to assist the associates to improve their prospects in their professional career; and (iii) to help science and technology permeate into industry and society. The membership of the society is open to CLRI students who have obtained their B.Tech., M.Tech. and Ph.D. degrees as well as the present students; trainees including those coming from foreign countries; staff of CLRI; visiting professors/scientists; and tanners associated with the institute.

The governing council of the society comprises: Dr Y. Nayudamma (*Patron*), Director General, Scientific & Industrial Research; Director, CLRI (*President*), and five scientists of the institute (*members*).

The annual membership fee for various categories of members is as follows: local members Rs 5; student members Rs 2; life members Rs 100; foreign members $ 3; and foreign life members $ 50.

Further particulars can be had from Dr C. Koteswara Rao, Secretary, Society of CLRI Associates, Central Leather Research Institute, Madras 20.

PATENTS SEALED

118995 : A process and a product for removing fluorides from drinking water, V. P. Thergaonkar, B. N. Pathak, D. N. Kulkarni, S. B. Padhye & K. R. Bulusu—CPHERI, Nagpur.

119088 : Production of technical and perfumery grade citronellol from *Eucalyptus citriodora* oil, C. K. Atal & V. N. Vashist—RRL, Jammu.

119189 : Improvements in or relating to the electrolytic preparation of potassium, H. V. K. Udupa and others—CECRI, Karaikudi.

119627 : Vibration sensitive switch, V. R. Dakshinamurthy, T. N. Ranganathan & V. K. Krishnankutty—CMERI, Durgapur.

120113 : Synthetic resin materials for use as filling agent in leather manufacture, J. H. Sharphouse & D. Mukherjee—CLRI, Madras.

120116 : A process for preparation of alkyl nitrate esters, P. Desikan & K. K. Bhattacharyya—IIP, Dehra Dun.

120257 : A process for the treatment of oilseed meal, particularly groundnuts and groundnut products, to destroy aflatoxin, to remove the nutty odour and to improve its colour and texture, V. Sreenivasamurthy, S. Srikanta & H. A. B. Parpia—CFTRI, Mysore.

PATENTS FILED

132327: Light weight clay bricks, blocks and tiles for insulation and multistoreyed constructions, K. B. Kacker, K. N. Agarwal & D. Chandra—CBRI, Roorkee.

133701: A process for the production of bisphenols by the reaction of phenols and ketones, C. S. B. Nair, P. R. Kumar, K. C. Bit, A. N. Basu & A. Lahiri—CFRI, Dhanbad.

134293: Improvements in or relating to a method for the selective extraction of nickel and cobalt from lateritic ores, P. K. Rao, S. B. Kanungo, D. N. Dey, R. K. Sahu & B. R. Sant—RRL, Bhubaneswar.

134374: Improvements in or relating to the electrolytic reduction of *p*-nitrophenol to *p*-aminophenol, H. V. K. Udupa, G. S. Subramanian, P. N. Anantharaman & A. Pourasamy—CECRI, Karaikudi.

134375: Preparation and application of insoluble anodes for electrochemical processes, R. T. Nadar, H. V. K. Udupa, B. R. Yadav & P. Subbiah—CECRI, Karaikudi.

134376: Improvements in or relating to a steam distillation unit for extraction of essential oils, B. C. Mohanty, S. Mohapatra & A. Parida—RRL, Bhubaneswar.

134377: Improvements in or relating to the preparation of pellets containing carbonate ores and carbonaceous materials, P. K. Som, S. K. Roy Chowdhury & S. C. Aush—NML, Jamshedpur.

134378: Tungsten sulphide-nickel sulphide on alumina catalyst for production of superior grade kerosene from L.T. tar and petroleum fractions, (Mrs) A. Mirza, M. A. Masood & R. Vaidyeswaran—RRL, Hyderabad.

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Thirteenth Technological Conference of ATIRA, BTRA and SITRA

The thirteenth Technological Conference, sponsored jointly by the Ahmedabad Textile Industry's Research Association (ATIRA), the Bombay Textile Research Association (BTRA) and the South India Textile Research Association (SITRA) was held at ATIRA, Ahmedabad on 19 and 20 February 1972. A feature of this annual conference was the participation of research institutions other than the three sponsors. Twenty-nine papers covering various areas of textile technology were presented. Of these, some 20 papers were of interest to the textile industry and the others were addressed mostly to research workers. Two of them were review papers, and one paper was concerned with an industry-wide survey.

Brief accounts of papers presented at the various sessions follow:

Spinning

An expression for short-term irregularity of roving has been obtained in terms of fibre properties, sliver irregularity, roving draft and condition of the roving frame, and presented in their paper by K. Govindarajulu and G. Srikantaiah (SITRA). The contribution of different factors for roving irregularity has been assessed and norms have been fixed for roving *U*%.

A mechanism of the formation of thick and thin places in ring-spun cotton yarns has been formulated by T. A. Subramanian, S. Bandyopadhyay and A. R. Garde (ATIRA). The difference between the number of thick and thin places taken together with their levels can be interpreted for identifying processes most likely to cause excessive number of thick and thin places in a given yarn. Experimental evidence has indicated that carding at rates conventionally used for superfine counts could provide a means of upgrading the quality of Indian cottons spun to medium counts. T. A. Subramanian and S. Bandyopadhyay (ATIRA) proposed in another paper a new equation for predicting the lea strength of a ring-spun cotton yarn from fibre properties. The equation has been found to be a good fit for yarns spun under different processing conditions, viz. carded (single and double roving feed), combed, and double-combed, using cottons of widely different properties.

In his paper, R. Sripathi (SITRA) presented the results of studies on the effect of top roll pressure on end breaks and yarn quality under varying cot hardness. It was found that better evenness and considerable reduction in end breaks can be achieved using softer cots at an optimum pressure of 13 kg.

The results of experiments conducted at SITRA on the rotor type of open-end spinning using a top arm drafting system for drafting from the rovings were presented by M. S. Parthasarathy and S. Govindarajan of SITRA. It has been possible to produce yarns superior to ring-spun yarns in evenness and regularity of strength and extension.

Improved transfer efficiency and reduced cylinder load do not always contribute to better yarn quality. According to the paper presented by S. K. Nerurkar and K. S. Murthy (BTRA), the method by which higher transfer efficiency is obtained has a critical bearing on the carding quality.

Of direct interest to the spinning technicians are the two papers 'Grinding of metallic card clothing and its influence on carding and yarn quality' (Ashok Hirway & S. N. Prabhune; BTRA) and 'Comparative performance of unicomb and conventional half-laps on comber' (R. G. Owalekar and P. T. Mathews; BTRA). In the first, an attempt has been made to establish correct grinding frequency and to assess the benefits derived from grinding in terms of sliver and yarn quality. It was shown in the second paper that with the same noil level, the quality of combing obtained with unicomb half-lap is comparable to that obtained with the conventional half-lap for medium count mixings. However, the quality of combing deteriorated when unicomb half-lap was used for combing fine and superfine mixings with the same noil level.

P. S. Jain (Delhi Cloth & General Mills Co., Delhi) showed in his paper that the digital fibrograph can be used for measuring the effects of fibre hooking in slivers, and that it gives reproducible results. The method is quicker and more reliable than the conventional cutting ratio technique.

Weaving and Engineering

The results of a study on the effect of yarn unevenness and thread densities on the appearance of patchiness in fabrics were presented by A. R. Garde, S. Bandyopadhyay and T. A. Subramanian (ATIRA). A quantitative method developed for assessing the appearance of a fabric and a relationship established for the dependence of fabric appearance on the thread density and crimp were also described.

N. M. Swami, M. K. Bardhan and A. Majumdar (Indian Institute of Technology, New Delhi) have investigated the accuracy of the standard method of measurement of yarn crimp by comparing the results with those obtained by direct measurement of the curvilinear length using a microprojector. An indirect experimental confirmation of the theoretically established relationships between modular length, thread spacing and crimp height was obtained.

A new design of air circulation system suitable for use in the spinning departments was given by S. P. Patel and K. Subrahmanyam (ATIRA). The paper by P. B. Jhala and K. Subrahmanyam (ATIRA) dealt with the theoretical studies and practical applications of the counter-current flow in textile washing machines.

Chemistry and Chemical Processing

The paper by E. H. Daruwalla and V. N. Sharma (BTRA) examined the colour yield in the dyeing of cotton using reactive dyes belonging to different reactive systems at 150° and 170°C, and of different disperse dyes on terene at 200°C using superheated steam as a medium of fixation. The results show that the rate as well as the extent of fixation of reactive dyes is higher when high temperature steam is used than in the case of the pad-dry-cure process at the same temperatures.

Cuprammonium fluidity is the conventional parameter used for assessing degradation of cellulosic materials. The results on viscosity measurements in cadoxen (cadmium ethylenediamine) and FeTNa (iron tartaric acid sodium) solvents have been shown by W. B. Achwal and S. R. Karmakar (Department of Chemical Technology, University of Bombay) to be correlated well with the cuprammonium fluidity; nomograms have been prepared for use in routine quality control in chemical processing.

V. A. Shukla, J. J. Shroff and H. C. Srivastava (ATIRA) described the synthesis of amides and their methylolation. The resulting derivatives were used on cotton fabrics which were dried and cured.

Two papers relating to durable press (DP) finishing of cotton textiles were presented. The paper by M. R. Ravikrishnan, R. C. Shah, K. G. Singaporewala and H. U. Mehta (ATIRA) showed that the performance during wear of fabrics resin-treated to the DP levels is a cumulative effect of various properties rather than of any single property such as abrasion. The other paper by J. David Reid and Robert M. Reinhardt (Southern Regional Research Laboratory, New Orleans, USA) was a critical review of recent research developments in DP finishing of cotton, with special reference to the work done in USA.

Studies on natural and reduced wool after graft copolymerization with methyl methacrylate, carried out by D. S. Varma, S. K. Chaudhuri and R. K. Sarkar (Indian Institute of Technology, Delhi), reveal that reduced wools generally give higher deposition than natural wool.

Three papers on operational studies were also presented at the conference.

Awards for Inventions and Import Substitution

The following thirteen processes/products developed by CSIR laboratories are among those selected by the Inventions Promotion Board, and Board on Awards for Import Substitution for the 1972 Republic Day awards:

Invention Awards

1. Improvements in tractors by reducing the number of levers for working the finger-tip automatic depth-cum-position control hydraulic system—Sarvashri G. S. Rihal & B. S. Devgun, Central Mechanical Engineering Research Institute, Durgapur; and Shri Chandra Mohan of Punjab Tractors, Chandigarh: joint cash award of Rs 1500.

2. Development of a soldering technique for use on aluminium condensers for refrigeration equipment—Sarvashri S. K. Bhattacharya, S. C. Basu & A. K. Bandopadhyay, Central Mechanical Engineering Research Institute, Durgapur: joint cash award of Rs 1500.

3. Process for the production of Syntan, a synthetic tanning agent for white tanning, prepared exclusively from indigenous materials—SarvashriD. Mukherjee, K. T. Sarkar & Dr Y. Nayudamma, Central Leather Research Institute, Madras: joint cash award of Rs 1500.

4. Development of lead dioxide electrodes used in the production of chlorates and perchlorates of sodium, potassium and ammonium in a single step—Dr H. V. K. Udupa & K. C. Narasimham, Central Electrochemical Research Institute, Karaikudi: joint cash award of Rs 1500.

5. Development of an improved apparatus for the production of *attar* and perfumed water—Dr A. Singh, Shri V. Chandra & Dr L. D. Kapoor, National Botanic Gardens, Lucknow: joint cash award of Rs 1500.

6. Development of Bandhani leathers by applying a new technique of dyeing leathers—Mrs R. Khanna, Sarvashri P. S. Venkatachalam, J. K. Khanna & K. B. Gupta and Dr Y. Nayudamma, Central Leather Research Institute, Madras: joint cash award of Rs 1500.

7. Development of a new solder and flux for jointing aluminium cables—Sarvashri B. A. Shenoi, R. Subramanian & S. Chakrapani, Central Electrochemical Research Institute, Karaikudi: joint cash award of Rs 1500.

8. Development of a process for the treatment of mammalian intestines from slaughter houses for utilization for the manufacture of absorbable surgical catgut/suture/ligature, plain and chromic or the like—Dr S. K. Barat and Shri Mahendra Kumar, Central Leather Research Institute, Madras: joint cash award of Rs 1000.

9. Development of a process for dyeing of wool, hair and other keratinous fibres into a fast non-bleeding jet black shade without using conventional dyestuffs—Dr S. K. Barat, Central Leather Research Institute, Madras: cash award of Rs 1000.

10. Development of an alkaline stripping solution for nickel-plated coating on steel by immersion method, which was formerly done electrolytically—Sarvashri S. K. Roy & A. N. Chatterjee, National Metallurgical Laboratory, Jamshedpur: a certificate of merit to each of the inventors.

Import Substitution Awards

1. Development of a wide range of microwave components like coaxial to waveguide adapter, fixed and variable attenuators, bends couplers, flanges, horns, frequency meters, waveguide detector mounts etc.—National Physical Laboratory

(NPL), New Delhi, and K.L.B. Electronics, Delhi: a bronze shield each to NPL and K. L. B. Electronics.

2. Substitution of imported fluorescence indicator grade silica gel from indigenously available raw materials—Sarvashri R. P. Mehrotra & Gouri Sethi Balamalliah, Indian Institute of Petroleum (IIP), Dehra Dun: a bronze shield to IIP and a certificate of merit to each of the inventors.

3. Development of an ultrasonic interferometer for the investigation of the velocity of sound by observing the interference patterns—Dr Vishwa Nath Bindal, Sarvashri Raj Kumar Nayar & Rakesh Kumar, National Physical Laboratory (NPL), New Delhi : a bronze shield to NPL and a certificate of merit to each of the inventors.

Brief accounts of some of the inventions are given in the following paragraphs. Write-ups on the rest of them will appear in subsequent issues of this news-letter.

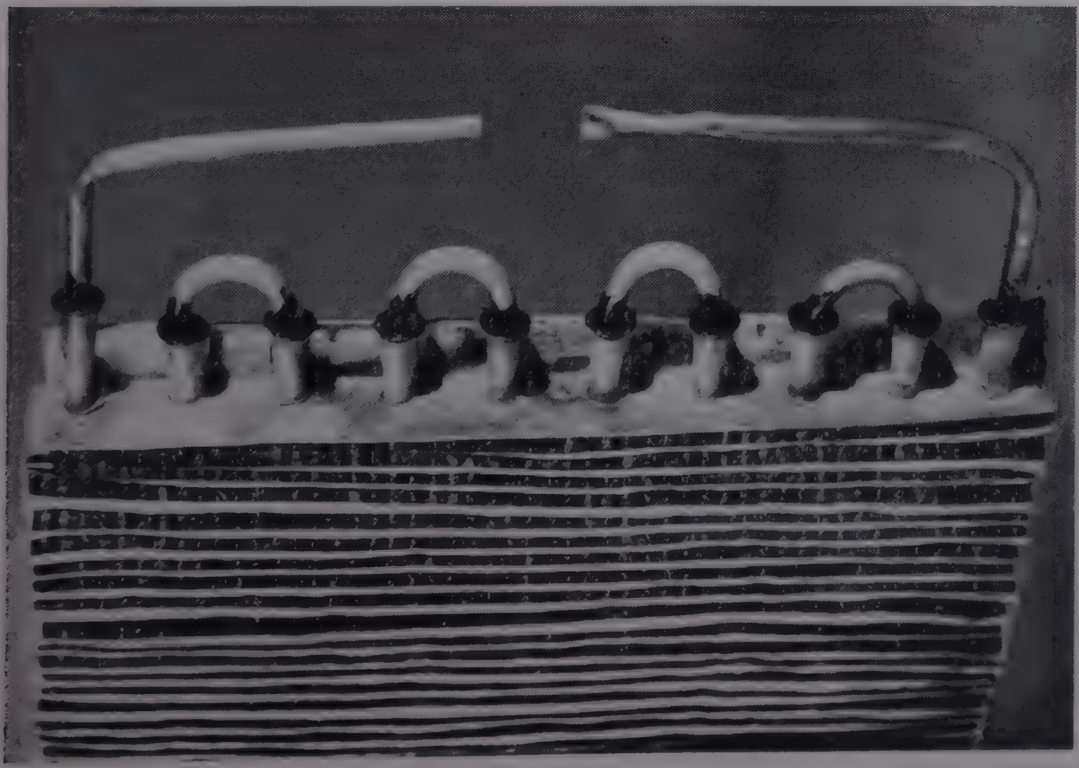
All-Aluminium Condenser

The technique developed at CMERI for manufacturing all-aluminium condenser for air-conditioners and water coolers leads to substantial savings in foreign exchange, as it replaces copper with aluminium.

The substitution of strategic non-ferrous metals, like copper, used in appliances in which heat transfer plays a dominant role has received considerable attention in recent years. By virtue of its high heat conductivity and corrosion resistant property in some environments, aluminium can replace copper in refrigeration industries. The main hurdle which so far stood in the way of using aluminium in the manufacture of all-aluminium condenser evaporator for air-conditioners, air-coolers, etc. is the lack of knowledge in regard to thermal joining of aluminium tube fins and return bends.

Copper tubes and brass fins are presently used for the manufacture of condenser, evaporator for air-conditioning condenser, water cooler, etc. The fin tubes are mechanically bonded and the return bend joints are made of Cu-Ag alloy or Ag-Cu-Zn alloy. Some manufacturers have switched over to the use of aluminium fins but they still use copper tubes. The absence of diffusion bonding between aluminium fins and copper tube has resulted in inefficient heat transfer.

The aluminium used for both the condenser and evaporator should be of such quality and grade that it can resist the reaction of gases and other liquids used in refrigeration. Experiments have shown that the tube conforming to IS : 738-1956 is satisfactory for the service conditions to which the condenser for an air-conditioner/water cooler is subjected. This grade of tube is indigenously available.



All-aluminium condenser produced by the technique developed by CMERI, Durgapur

To obtain a satisfactory joint, tubes and fins should be cleaned free of oil, grease and other foreign materials. Immediately after they are cleaned, tube fins are joined in conformity with the design. The assembly is held together by a fixture. For the actual soldering operation, a horizontal box type air circulation furnace is recommended. The temperature is maintained at 410°C, and after it is dipped into the flux slurry the assembly is transferred to the furnace and kept for a pre-determined time. At the reaction temperature, the flux deposits sufficient quantity of metal to complete the tube fin joint and leaves a thin layer of metal on the surface of the assembly. No additional filler metal is necessary.

To join return bends, the tube should be flared with a suitable tool, and then the upper tube should be inserted. The same flux with a filler metal made of Zn-Al eutectic is used for the purpose. Return bend joints have been tested in a hydraulic press, and found to resist the pressure required in an air-conditioning condenser, or a water cooler condenser.

The free ends of the condenser tube are provided with a small piece of copper tube, so that they may be connected in the compressor. A solder of Zn-Al eutectic or pure zinc with the flux is most suitable for this type of joints. Tests conducted on Cu-Al joints made by this method have given satisfactory results. When zinc is used, care must be taken with regard to the heat supply so that an intermetallic compound is not formed. When used in moist environment the Cu-Al joints should be suitably painted.

A popular model has been selected and tested. The efficiency of an all-aluminium condenser is quite satisfactory, and the condenser is suitable for use in the air-conditioning industry. The aluminium condenser costs about Rs 122, whereas an aluminium-copper condenser costs about Rs 315. The know-how has been commercialized by two firms.

Lead Dioxide Electrodes

These electrodes can be used as insoluble anodes in the production of sodium and potassium chlorates (which are required in tonnage quantities in the match industry) and improve the life of the conventional graphite anode. The electrodes can also be used as a substitute for platinum anodes in the production of perchlorates such as potassium perchlorate, ammonium perchlorate and magnesium perchlorate which are required as explosives, rocket fuels and as dehydrating agents, respectively. The lead dioxide anode also finds application in the production of various other inorganic electrochemicals like bromates, iodates, periodates of sodium and potassium and some organic chemicals.

The process (Indian Pat. 66195), developed by CECRI, Karaikudi, consists in the electrodeposition of lead dioxide on graphite and/or carbon substrate from a lead nitrate-copper nitrate bath; during the deposition, plate electrodes are given a to-and-fro motion, whereas rod electrodes are rotated. The lead dioxide deposit obtained on the graphite and/or carbon substrate is free from pores and the deposit is adherent and compact.

The deposition of lead dioxide on graphite serves two purposes: (i) effects electrical contact to lead dioxide electrode by acting as the current lead, and (ii) protects the graphite itself from disintegration. Even if the lead dioxide peels off, the graphite will not introduce harmful impurities in the bath, and redeposition of lead dioxide on used graphite can be effected. The optimum conditions for the deposition of lead dioxide were thoroughly studied in the laboratory. Bigger graphite rods and plates suitable for commercial scale cells have been deposited with lead dioxide by the use of this technique. Later, the deposition of lead dioxide was carried out on stationary graphite rods and plates from lead nitrate bath containing quaternary ammonium cationic surfactants; the deposit was smooth, adherent and free from pinholes.

The use of graphite substrate lead dioxide anodes in chlorate production not only improves the life of the graphite anodes but has the following advantages:

(1) The effluent from the chlorate cell is clear without graphite contamination unlike in the case of cells using graphite anodes; thus, filtration of the liquor before processing the chlorates (sodium or potassium) is avoided.
(2) Electrolysis can be continued even when the chloride concentration is below 100 g/litre.
(3) Higher current efficiency.
(4) Cell voltage is constant during the entire period of electrolysis.

Lead dioxide-deposited graphite electrodes of varying sizes and shapes for use in cells of various amperage capacity

In the perchlorate cell, the bat voltage is lower when the graphite substrate lead dioxide anode is used than when platinum is used.

The graphite substrate lead dioxide anode alone can be used for the direct electrolysis of chloride to perchlorate without intermediate processing, whereas the present conventional process involves the use of two different anodes and different operating conditions and intermediate processing of the chlorate.

The cost of deposition of lead dioxide of 1 mm thickness over 1 dm² area is about Rs 2·85 excluding the cost of substrate.

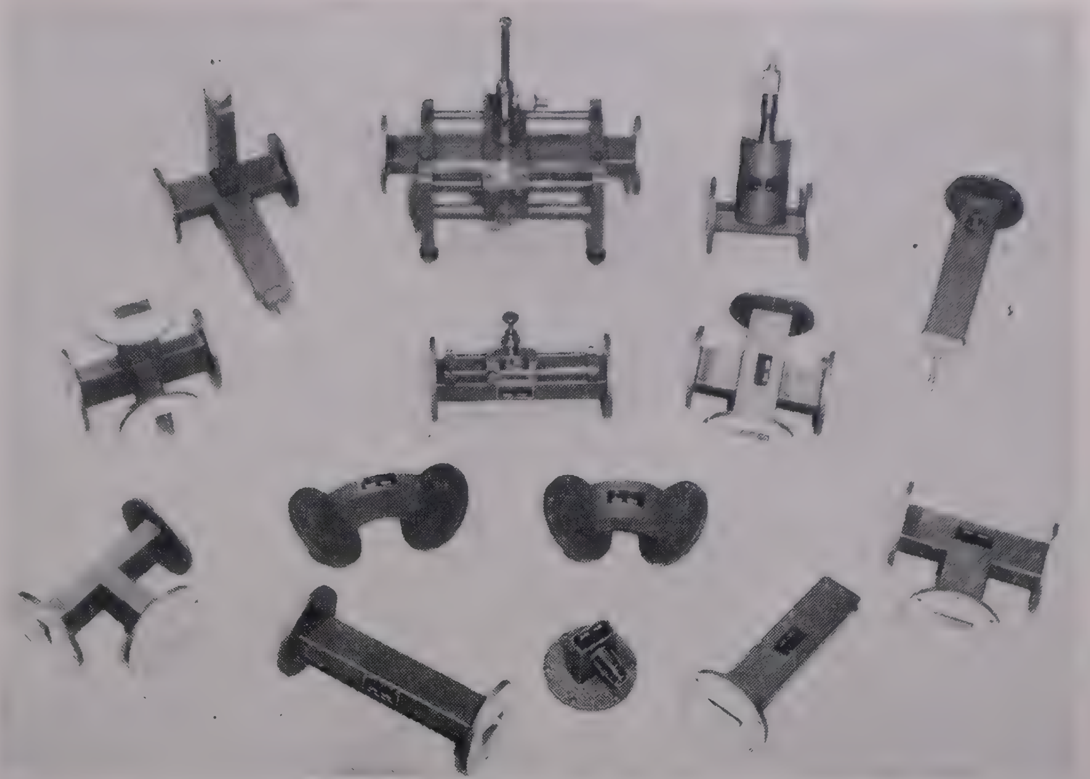
No import of machinery or raw material is necessary, and savings in foreign exchange as a result of replacing platinum in perchlorate production would be considerable.

Bandhani Leather

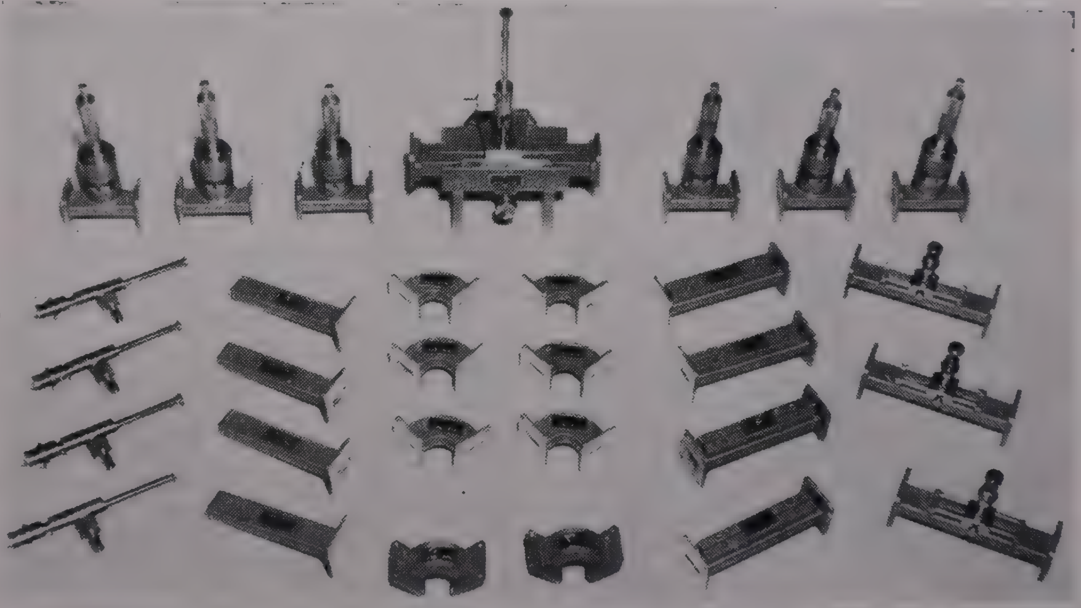
This invention relates to a technique developed by the Central Leather Research Institute (CLRI), Madras, for producing attractive leather and leather articles from rejected goat and sheep skins. Brilliant and multicoloured floral effects can be produced by this technique, known as Bandhani technique, and the defects in the rejection skins can be completely masked by suitable dyestuffs. A rejection skin which normally fetches Rs 6-7 can be sold for Rs 20-25. Several tanneries have utilized the new technique and are producing leather both for export and local consumption. The institute has also manufactured and

Leather garment made by a dyeing technique (known as Bhandani technique), developed by CLRI, Madras, for producing from rejected goat and sheep skins attractive leather and leather articles sold about Rs 30 000 worth of this attractive leather. All kinds of fashion items like garments, bags, pouches and slippers can be made from this leather.

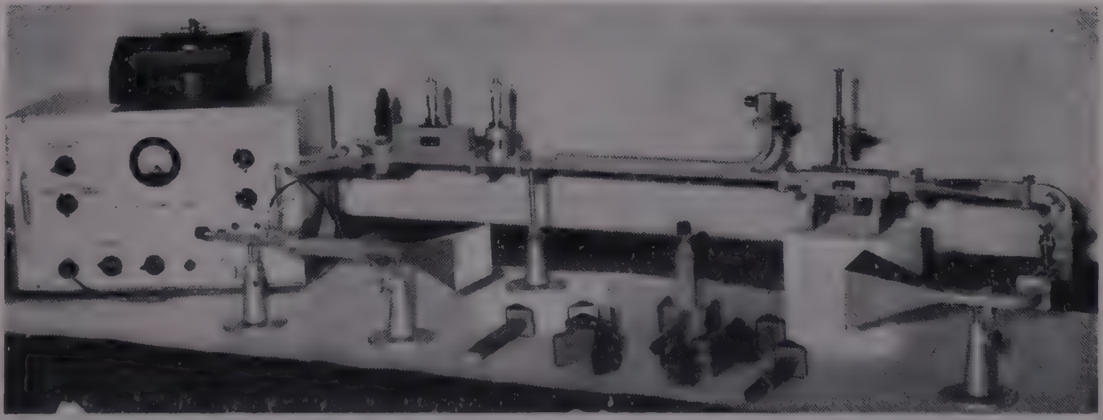
The leathers are laid flat on a table and the spots where the tying has to be done are marked out using a template. The places are then tied at the spots to a definite length using twine, and are dyed in a tub. After the first dyeing, knots are removed and the leathers are re-tied in fresh spots according to the pattern or design proposed. They are again dyed; knots are cut open and the pieces are given a fixing treatment followed by showerproofing. Subsequent treatments are the same as are required for producing normal suede leathers. The final product is a multicoloured attractive leather.



Microwave components for C/XN band designed and fabricated by NPL, New Delhi



Microwave components for X-band designed and fabricated by NPL, New Delhi



Microwave (X-band) text bench designed and fabricated by NPL, New Delhi

Microwave Components

Because of their short wavelengths, microwaves can be radiated in space in the form of a narrow beam, unlike radiowaves used for broadcasting, and are therefore ideally suited for use in radar systems, microwave communication links, satellite communication, navigation, and research. Microwave components used in the microwave applications are highly sophisticated in design and fabrication, with close mechanical and electrical tolerances in their performance. As the demand in regard to these devices is met by import, the National Physical Laboratory (NPL), New Delhi took up a project on the design, development and batch-production of microwave components required in various microwave systems.

Within a microwave system, microwave energy is transmitted from one point to another through hollow metallic pipes, known as waveguides, of suitable dimensions and good interior surface finish. Techniques for fabricating seamless waveguides have been perfected by NPL. A machine for drawing waveguides has been designed and fabricated. With suitable dies the machine can be used for drawing waveguides of any size suitable for different microwave frequency bands in copper, brass or aluminium.

Apart from straight waveguides, a variety of microwave components like T junctions, directional couplers, attenuators, pyramidal horns, matched terminations, twists and bends are used in the above mentioned systems. The designs and techniques of fabricating 25 different types of components have been perfected. These components include specialized items like slotted lines with probe for the measurement of impedance, broadband circulators and isolators for non-reciprocal transmission, frequency meters, and variable attenuators for adjusting the microwave power level.

A complete microwave test-bench comprising 27 components including klystron and its associated power supply has been developed by NPL, and is being manufactured by K.L.B. Electronics. A complete bench costs Rs 13 000, whereas an imported bench costs Rs 24 000. These microwave components are in great demand by university departments and research institutions concerned with training and research in microwave engineering.

Microwave components worth Rs 3 00 000, leading to a saving of foreign exchange equivalent to Rs 8 00 000, have been produced by the laboratory.

The technical know-how for the production of X-band microwave components (3 cm wavelength) was passed on to K.L.B. Electronics, New Delhi in 1968, and the knowhow in respect of C/XN band (5 cm) components was released to the same firm in 1971. The firm has produced components worth Rs 5 00 000 during the last 3 years corresponding to a saving in foreign exchange of Rs 12 lakhs.

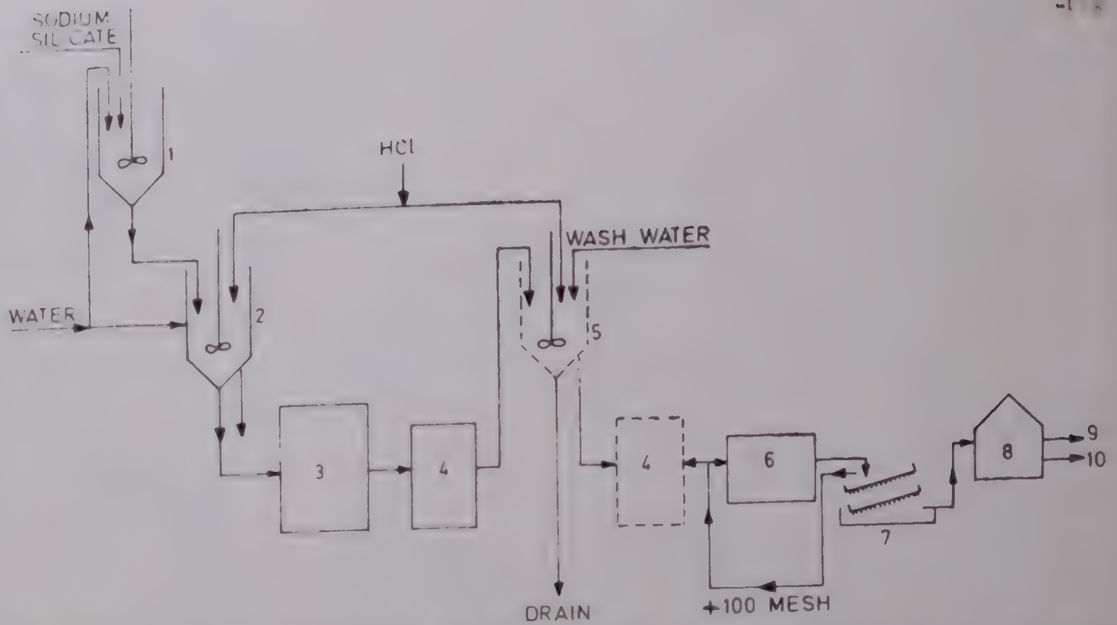
FIA Grade Silica Gel

A special grade of high purity silica gel is employed in the fluorescent indicator adsorption (FIA) method of estimation of aromatics, olefins and saturates in gasolines and kerosenes. The ASTM test procedure D-1339-66T recommends the use of Davison grade 923 silica gel (100-200 mesh). It has a very low level of mineral impurities (0.05%) to ensure minimum olefin polymerization and its pore structure is conducive to good selectivity, capacity, rate of adsorption and sharpness of resolution in aromatic-olefin-saturate separation. A finer mesh product can also be used as a substitute for Davison grade 922 silica gel (as per ASTM method D-936) for the separation of aromatics.

The process developed by the Indian Institute of Petroleum, Dehra Dun, consists of gel formation, ageing, drying, washing, sizing and calcination steps. The variables are chosen in such a way as to yield a product of desired chemical purity and pore structure. However, the innovation lies in the sequence and simplification of various steps and use of indigenous materials as a result of which the costs of equipment and production are reduced considerably. A feature of the process is the successful use of a simple and inexpensive method of drying, which is a critical operation in the preparation of materials with specific pore structure. The main raw materials, viz. sodium silicate and hydrochloric acid, are indigenously available.

The cost of production works out to Rs 75-80/kg when the material is prepared on a 4 kg/batch scale, the imported material costs about Rs 100/kg.

Earlier, the entire requirement of FIA grade silica gel was met by imports. To supplement the requirement of user industries, IIP is producing the silica gel at the rate of 4-5 kg per month. The material is being supplied to Indian Oil Corporation Ltd, Hindustan Steel Ltd, Assam Oil Co., Caltex, and other users. The silica gel produced by IIP has been found by the user industries to be comparable in performance to the imported material. The internal requirements of the institute are also being met from departmental production.



Flow diagram for preparation of FIA grade silica gel, the process which has been worked out by IIP, Dehra Dun [(1) solvent tank; (2) mixing vessel; (3) ageing chamber; (4) tray drier; (5) washing vessel; (6) ball mill; (7) double deck vibrating screen; (8) activation furnace; (9) silica gel (100-200 mesh); and (10) silica gel (-200 mesh)]

PROGRESS REPORTS

CIMPO REPORT: 1968-1970

The report of the Central Indian Medicinal Plants Organization (CIMPO), Lucknow for the years 1968, 1969 and 1970 published recently, records the progress of research and development activities of CIMPO headquarters, its zonal centres, drug farms and drug research laboratories (factories). The headquarters at Lucknow and the zonal centres at Bangalore and Haldwani acted as developmental and promotional units for spreading the cultivation of medicinal and aromatic plants throughout the country; the drug farms and factories in Jammu and Kashmir acted as commerical units and were engaged in the production of medicinal and aromatic plants, their constituents and other pharmaceutical preparations.

Cymbopogon martini var. *motia*, which gives oil of palmarosa, has been grown at Lucknow; and by selection, a strain of the plant yielding oil conforming to IS specification has been produced. The oil is a good foreign exchange earner, and during 1968-69, about 31 tonnes of the oil valued at about Rs 37 lakhs were exported. *Mentha piperita* has been successfully cultivated, and the oil of peppermint, obtained from the plant, has been found to be of BP quality. The plant has also been introduced in the drug farm, Jammu and the quality of oil has been found acceptable to industry. At present, the requirements of this oil are met by import; about 160 tonnes of the oil valued at about Rs 68 lakhs were imported during 1968-69. A new strain of lemongrass having 90% citral has been evolved at Lucknow by irradiation and selection.

M. piperita and *M. arvensis* were found to grow well in the alkaline soils of CIMPO experimental farm at Banthra (Lucknow). Also, the oils obtained from the crops were of acceptable quality.

Production of spearmint oil, used as a carminative, is negligible and the country's demands are being met by import. Under the conditions obtaining at Lucknow, flowering *M. spicata* has been found to yield oil of spearmint of BPC quality. An improved variety of Java Citronella plant with high geraniol and aldehyde contents has been produced at Lucknow through selection. Total aldehyde content (as citronellal) and total alcohol content (as geraniol) have been found to be 45.5% and 96% respectively. The oil obtained from the plants grown on the alkaline soil of the CIMPO Banthra Research Station was found to contain 91.6% total alcohol as geraniol and 44.7% total aldehyde as citronellal; the oil conforms to IS specifications.

The oil of dill (*Anethum graveolens*) seed is carminative and is used in dill water in the treatment of flatulence in infants. It is also used for the isolation of carvone, and has good demand in the country. The plant, grown successfully at Lucknow, contained 3.5% essential oil, which is much higher than the limit prescribed by Indian Pharmacopoeia (2.5%).

Atropa belladonna has been successfully cultivated on an experimental scale at Lucknow. The dry herb has been found to contain 0.324% (w/w) of total alkaloids, calculated as hyoscyamine, which is higher than the Indian Pharmacopoeial limit—not less than 0.3%. The cultivation of belladonna as an annual crop in the plains could help meet the demand from the pharmaceutical industry.

The Haldwani centre paid considerable attention to the production of *M. arvensis* (Japanese mint) and its extension in the surrounding areas. During 1968-71 about 700 kg of oil were produced from 20 ha under *M. arvensis*.

Weeds hinder extension of *M. arvensis* in the Tarai area of Uttar Pradesh. Manual weeding is expensive and time-consuming. Trials on weed control using chemicals were undertaken at the Haldwani centre, and out of the eight weed killers tried, only Terbacil (Dupont) proved effective. The effective rate of spray of Terbacil was 2 kg/ha.

Cultural trials on four *Mentha* sp., viz. *M. arvensis*, *M. piperita*, *M. spicata* and *M. citrata*, to find out the most suitable method of planting for the Tarai region and its effect on the yield of herbage were carried out at the Haldwani centre. Of the two methods of planting, viz. flat planting and ridge planting, the latter was found better under Tarai conditions.

Authentic planting materials of citronella (*Cymbopogon winterianus*), geranium (*Pelargonium graveolens*), patchouli and linaloe (*Bursera delpechina*), a native of Mexico, have been evolved at the Bangalore centre. The centre studied, standardized and recorded the details and economics of cultivation of these plants, and worked out distillation techniques for obtaining the essential oils from them.

The following twelve exotic plants, obtained from Bulgaria, were introduced in the Belur farm: *Coriandrum sativum*, *Salvia officinalis*, *Matricaria chamomilla*, *Anethum graveolens*, *Mentha piperita*, *Valeriana officinalis*, *Glaucum flavum*, *Salvia sclaria*, *Lavandula vera*, *Atropa belladonna*, *Pimpinella anisum and Foeniculum officinalis*. Of these, *C. sativum* was most encouraging and its cultivation on a large scale is being undertaken. *F. officinalis* and *M. chamomilla* were found to be very promising.

The drug farms at Jammu were engaged in the production of oil of *M. arvensis*, oil of *M. piperita*, *Ammi majus*, ergot and rotational crops; and the drug farms in Kashmir were mainly concerned with the production of belladonna, pyrethrum, *M. piperita* and ergot.

The effect of nitrogen and phosphorus on the yield of belladonna was studied at Mansabal farm and the optimum level of nitrogen for belladonna was found to be 120 kg/ha; phosphorus did not affect the yield.

Optimum doses of nitrogen, phosphorus and potash for *M. piperita* were found to be (per hectare) 180 kg, 60 kg and 50 kg respectively; none of the fertilizers affected the oil content.

The main items produced at the Drug Research Laboratory (factory), Jammu were menthol, diosgenin, belladonna alkaloids (total), extracts, gallenicals, tinctures, spirits, tablets and injectives. Items produced at the Drug Research Laboratory (factory), Srinagar were cedarwood oil, pyrethrum oleoresin and hyoscyamine (from *Physochlina praealta*). A new essential oil from *Ferula jacksiana* has also been produced at the Srinagar factory, and has found a good market.

The report includes 10 appendices relating principally to technical aid rendered to industry, research papers published, and production and sale figures in regard to essential oils, drugs, planting stock, etc. at various CIMPO centres. Thirty-five research papers were published by CIMPO during the period under report.

IJIRA Annual Report : 1970-71

The annual report of the Indian Jute Industries' Research Association (IJIRA), Calcutta for the year 1970-71 highlights the efforts made for obtaining higher yields of jute through agronomic research. A long-term project for evolving genetic mutations of jute with increased fibre yields, sponsored by IJIRA at the Indian Agricultural Research Institute (IARI), New Delhi, was continued. Trials on the growth of some mutant seeds produced at IARI, and the Bhabha Atomic Research Centre, Bombay, were carried out at several places. Line sowing with a 6 in spacing between the rows was found to produce higher jute yields, particularly in *Olitorius* varieties.

Laboratory and field experiments in retting were continued; a simple method of securing better retting near the root end of a seed was tried successfully in the field. Two experiments were conducted in member mills for improving the quality in carding and productivity on broadlooms; encouraging results were obtained. Other projects under trial in member mills for reducing costs relate to: increasing use of fibre upgrading; improved sizing recipes; control of moisture at spinning, weaving and finishing; and a system of tuning broadlooms.

Investigations on the development of jute bags with reduced seepage, and the design of more durable and economical bags for fertilizers were continued. The Association has acquired, and is capable of providing, know-how for imparting to jute fabrics different finishes for softer feel, improved wrinkle recovery and reduced fibre shedding; this know-how would be useful to the jute industry in producing sophisticated jute fabrics.

PATENTS ACCEPTED

Indian Pat. 125358

Preparation of cellulose acetate semi-permeable, flat or tubular, osmotic membrane

M. V. Chandorikar, D. J. Mehta & A. S. Kane
CSMCRI, Bhavnagar

The process covered by the patent specifies the conditions for the preparation of cellulose acetate semi-permeable osmotic membrane (flat or tubular) which can be used in the reverse osmosis plant for separating the solutes from solutions without changing the phase.

The process consists of five steps: preparation of casting solution, casting of membrane, evaporation, cold water immersion treatment, and annealing treatment. The conditions for these steps have been worked out. It has been found possible to get either a low-productive but high-rejective ('tight' type) membrane, or a high-productive but low-rejective ('loose' type) membrane.

Using the flat or tubular cellulose acetate semipermeable membrane in the reverse osmosis plant, fresh water of high quality can be obtained from brackish water or from industrial effluent at a considerably cheap rate. This membrane can also be used for the separation of solutes and solvents, or for the concentration of solutes.

Indian Pat. 129746

Improved process for manufacture of pine oil from turpentine oils of low pinene content

K. Ganapathi, P.R. Rao, M.C. Nigam, C.D Padha & S.N. Sapru
RRL, Jammu

The process covered by this patent deals with the production of pine oil from turpentine oils of low pinene content such as *Chir* pine oil of Jammu and Kashmir State. These oils contain only 35-40% of pinenes, the rest being mostly carene with small quantities of longifolene. Hydration of the terpenes is known to be effected by shaking with sulphuric acid. The difficulty of intimately mixing the acid and the oil layers is avoided in this process by establishing conditions whereby a single phase is produced by the addition of acetone. Even without recourse to stirring, and by keeping at room temperature, turpentine oil is converted into pine oil having 75% of terpene alcohols (calculated as α-terpineol). Thus in a typical process, turpentine oil (50 l) is dissolved in acetone (200 l), and sulphuric acid (40%, 21.5 l) is added. The mixture is kept at room temperature and the acid is neutralized with alkali and distilled to recover acetone. The residual mixture on steam distillation gives pine oil (sweet smelling) of about 75% alcohol content.

The process has the following advantages:

(1) The reaction is carried out invariably at room temperature whereby heating costs are avoided.

(2) In a homogeneous phase reaction no shaking is needed; violent heavy shakers are otherwise necessary to bring close contact between sulphuric acid and the turpentine oil layers.

(3) The use of acid-resistant distillation units is avoided by neutralizing the reaction mixture before distillation.

PATENTS FILED

134398: Improvements in or relating to the production of paper board suitable for making low cost paper houses, N. C. Nandi, B. P. Chaliha, A. C. Khazanchi, S. B. Lodh & M. S. Iyengar—RRL, Jorhat.

134415: A process for production of high purity water by solar stills, S. D. Gomkale, H. D. Goghari & R. L. Datta—CSMCRI, Bhavnagar.

134482: Viscopump-bearing-seal, a device for supporting axial-radial loads and dynamic sealing, S, K. Tewari—NAL, Bangalore.

134483: Improvements in or relating to the formulation of a dry developer (toner) for imaging in zinc oxide electrostatic photocopying process, C. V. Suryanarayana, A. S. Lakshmanan & J. Kuppusami—CECRI, Karaikudi.

134547: Air humidifier coo circulator, S. K. Banerjee—CMERI, Durgapur.

PATENTS SEALED

118517: An insecticidal vaporant for household and industrial pest control, S. M. Ahmed & S. K. Majumder—CFTRI, Mysore.

119163: A new process for making iron ore pellets, M. S. Iyengar, S. N. Dutta, B. C. Jana, I. K. Awatramani & P. C. Saikia—RRL, Jorhat.

120363: A process for the extraction from commercial black cutch of a material that can be used instead of *kattha* in the preparation of *pan* and *pan masala*, J. G. Srivastava—NBG, Lucknow.

120490: Paddy transplanting machine, A. K. Das—CMERI, Durgapur.

120704: Process for the preparation of potassium carbonate and N-K fertilizer using ion-exchange technique, D. R. Baxi & M. C. Modi—CSMCRI, Bhavnagar.

121151: Improvements in or relating to electrolytic deposition of gold on Kovar, D. M. Kishore—CEERI, Pilani.

Patenting of CSIR Processes

The President, Council of Scientific & Industrial Research, has accepted the recommendation of the Sarkar Committee (Committee of Enquiry, CSIR) in regard to the taking out of patents by CSIR employees in respect of those processes or inventions which CSIR itself would not patent. The Sarkar Committee's recommendation (No. 48 vide Part II of their report) reads:

"The decision to get an invention patented or not should be taken by the newly proposed Patents Committee. If the CSIR decide not to take out a patent in respect of a particular invention or discovery and the research workers concerned apply for permission to take out a patent in their own names and at their own cost, such permission should ordinarily be granted with the proviso that 25% of the royalties received should be credited to the CSIR revenues".

The President, CSIR, has also observed: "Patents may be taken out more liberally so that denial of taking out a patent should be rare".

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Convention of Indian Institute of Mineral Engineers at NML, Jamshedpur

The fourth Annual Technical Convention of the Indian Institute of Mineral Engineers (IIME), organized jointly by IIME and the National Metallurgical Laboratory (NML), Jamshedpur, was held on 19 and 20 February 1972 at NML. Attended by more than 100 delegates from research institutions, government departments and industries, the convention focussed attention on the importance of beneficiation and agglomeration of ores for the development of mineral-based industries.

Eighteen technical papers including six from NML were presented and discussed at the convention.

In their paper, B. L. Sen Gupta and G. P. Mathur of NML covered recent studies on the pelletization of Indian iron ore fines with particular reference to the Donimalai and Bailadila ores. With the increased production of iron ores, both for domestic consumption and export, the proportion of fines generated during various operations will increase. This brings to the fore the importance of developing methods for utilizing these fines by agglomeration after beneficiation, if necessary. A pot grate furnace fabricated and installed at NML for studying drying, preheating and firing behaviour of pellets under simulated conditions is of considerable use in this regard.

A paper presented by workers from Bhabha Atomic Research Centre, Bombay was concerned with bench scale studies on the recovery of economic minerals from carbonatite (Sevattur, Tamil Nadu). A flowsheet for the recovery of Nb-Ta concentrates (pyrochlore) and acid grade phosphate (apatite) from the carbonatite was presented.

The paper entitled ‘Beneficiation of a complex Cu-Pb-Zn ore from Dariba-Rajpura area, Rajasthan’, presented by P. V. Raman, S. K. Sengupta and G. P. Mathur of NML, set out the optimum flotation conditions for the production of satisfactory grades of copper, lead, zinc, and pyrite-pyrrhotite concentrates. Bulk flotation of copper-lead minerals at *p*H 8·9 followed by differential flotation employing NaCN produced concentrates analyzing to 24·6% Cu and 63·5% Pb with recoveries of 70·5% Cu and 92·2% Pb respectively. Activation of sphalerite from the copper-lead tailing followed by repeated cleaning of the zinc float yielded a final concentrate analyzing to 53·5% Zn with 82·5% recovery. The pyrite-pyrrhotite concentrate recovered from the Zn tailings had a weight recovery of 3·2 and analyzed to 37·95% S. The copper and lead concentrates contained 766 and 780 g of Ag per tonne respectively.

The results of studies on the beneficiation of a sample of pyrite-pyrrhotite from Saladipura (Rajasthan) were presented by P. D. Prasad Rao, C. Satyanarayana, K. Vijayaraghavan and G. P. Mathur of NML. In bench scale tests, grinding the 93% −200 mesh (T.S.S.) ore with 0·24 kg/tonne of potassium ethyl xanthate (KEX), 0·045 kg/tonne of pine oil and 3·0 kg/tonne of H_2SO_4 (*p*H 5·2-5·7), resulted in a concentrate (53·3% by weight) assaying to 40·5% sulphur with 91·8% recovery. Pilot plant tests indicate that 85% −200 mesh (T.S.S.) ore ground with 0·22 kg/tonne of KEX, 0·03 kg/tonne of pine oil and 3·0 kg/tonne of sulphuric acid along with reclamated water produces a concentrate (48·5% by weight) assaying to 41·5% sulphur with a recovery of 94·9%.

Beneficiation studies on the phosphorite deposits in India with particular reference to Mussourie, Maldeota, and Kanpur formed the subject of a paper presented by Ch. Rambabu and K. K. Majumdar of BARC, Bombay. Mussourie rock, which contains cherty and quartzitic gangue, could be upgraded by the usual methods—attrition grinding, sizing, agglomeration, tabling and oleic acid flotation. But in the case of Rajasthan rocks having calcite gangue, suitable calcination methods have to be employed. From a Kanpur rock assaying to 16·4% P_2O_5, concentrates assaying to 34% P_2O_5 and conforming to the specifications of the acid grade material were obtained with good recovery. Maldeota rock containing calcite gangue plus some pyrite was not amenable to beneficiation.

The results of the beneficiation studies on graphite from Srikakulum and Visakhapatnam Districts of Andhra Pradesh were reported by K. Kameswara Rao of the Andhra University, Waltair. The samples were subjected to flotation tests in various size grades using turpentine, kerosene, pine oil, and crude oil as frothers; xanthate, brown coal-tar oil and cresol as collectors; sodium silicate as a depressor; and sodium hydroxide and sulphuric acid as *p*H regulators. The size fractions range from −20 to −200 mesh with a pulp density of 20-25% solids. Selection of the reagents, size grades and *p*H depends on the nature of the mineral constituents. Flaky and needle type graphite gives a very good flotation concentrate containing up to 96% graphitic carbon, and the fine size grade gives up to 98%. The rest (2-4%) is mainly mica, quartz and feldspar. Garnet gives trouble during grinding and hence at one stage the coarse flotation concentrates have to be subjected to tabling and the table high-grade middlings are further treated for increasing the total recovery. Hydrofluoric acid treatment gives a product of 99·9% carbon content.

The results of beneficiation studies carried out at NML on the low grade molybdenite sample (0·038-0·168% Mo) from Tamil Nadu, were presented by C. Satyanarayana, M. V. Ranganathan, S. K. Banerjee and G. P. Mathur. The samples consisted of quartz, feldspars and mica with minor amounts of pyrite, chalcopyrite, magnetite and molybdenite. The molybdenite was fairly medium grained and flaky in appearance. Selective flotation of molybdenite with fuel oil and cresylic acid yielded encouraging results, the concentrates assaying to 43·0-54·7% Mo with 71·0-81·6% recoveries. The concentrates were suitable for commercial utilization.

The uses of heavy media hydrocyclones in mineral beneficiation were reviewed by D. M. Chakrabarti of NML. Some of the important contributions on the use of dense media suspensions in hydrocyclones for effecting separation between minerals, on the basis of their specific gravities, were reviewed.

G. K. Bandyopadhyay and T. C. Rao (IIT, Kanpur) reviewed the model building and hypothesis testing in: (i) regressional analysis for control and optimization, (ii) statistical design for screening variables, and (iii) statistical screening of particular materials. V. Malleswara Rao (Osmania University, Hyderabad) discussed the factors influencing the size distribution and the shape of the particles produced during crushing. An IR spectroscopic method for the identification of adsorbed species on lead minerals was presented by M. S. Prasad of NML.

Some of the other papers dealt with: (i) Heap and bacterial leaching studies on samples of low grade uranium ore from Keraudungri (Bihar); (ii) Possibilities of extracting gallium from bauxites of Orissa; and (iii) Development of a flowsheet for the reconcentration of a wolframite-scheelite concentrate.

Awards for Inventions and Import Substitution*

Solder and Flux for Joining Aluminium Cables

Aluminium is replacing copper in electrical transmission and distribution. More than 1 00 000 tonnes of copper are needed every year for these purposes. Almost the entire demand has to be met by imports. Of all the metals, aluminium has the maximum mass conductivity for electricity—more than twice that of copper—with the added advantages of economy, light weight, high corrosion resistance, and ease of workability. Both the manufacture of aluminium conductor and generation of electricity have registered a steady increase of 20% every year. With India's meagre resources of copper ores and inexhaustible reserves of bauxite ores the switchover to aluminium is inevitable.

Aluminium cannot be soldered easily and satisfactorily with the conventional methods of soldering copper, brass, etc. This is due to the presence of an oxide film which is resistant to chemical attack. The methods available today for soldering aluminium make use of a flux capable of destroying the oxide layer, preventing the surface from reoxidation and presenting a pure, virgin metal surface to the action of molten solder. Till very recently, the entire demand for solder and flux required for joining aluminium cables was met by imported products. This involved a considerable amount of foreign exchange, and therefore the Indian Railways, envisaging the replacement of copper wires with aluminium wires in rail wagons and coaches, referred the problem to the Central Electrochemical Research Institute, Karaikudi in 1964. New formulations of solder and flux for jointing aluminium (Indian Pat. 95420) were developed by the institute.

The flux (organic) destroys the oxide at the temperature of soldering and helps smooth and continuous flow of the molten solder over the aluminium surface.

The soft soldered joints are prone to loss of strength due to the corrosion of dissimilar metals on continued exposure to moist air. To minimize corrosion the composition of the solder has been formulated after extensive trials, and the joints made with the solder remain stable and strong under normal service conditions as shown by tensile tests. The solder (mp 200-240°C) is based mainly on tin and zinc.

Normally, no special preparation of the aluminium surfaces is required before soldering provided the surfaces are in a bright condition. If the surfaces are very dirty, they may be cleaned by abrasion or dipped in hot trisodium phosphate solution (5%), rinsed and dried before joining.

All the ingredients of the solder and flux, except tin, are indigenously available. The performance of tin-soldered joints made with CECRI solder and flux is comparable to the performance of joints made with imported products. Dissimilar metals like aluminium and copper can also be jointed, but the soldered joints should be covered with an insulating lacquer.

The flux and the solder can be used for joining aluminium cables, wires, etc.; joining aluminium stranded wires or cables with copper wires or cables, etc.; pegging leak holes in aluminium tanks and vessels; and for several similar applications.

The solder is made by mixing and melting the individual metal ingredients in the form of bits. The main equipment required are heating pans of steel, gas burners, and sand casting moulds. The preparation of flux consists in dissolving the constituents one after the other in a specified order taking care that not much heat is evolved. The equipment consists of mixing vessels, stirrers and packing bottles, all made of polythene. The solder and the flux can be manufactured on small industry scale.

The solder and the flux prepared at CECRI were sent to various interested parties for trial, and the test reports received from them are satisfactory.

The know-how for the production of 10 000 kg of solder and 4500 litres of flux per annum has been worked out. The cost of production of solder and flux works out to Rs 28·65/kg and Rs 14/litre respectively. The process has been licensed to two entrepreneurs.

Ultrasonic Interferometer

The ultrasonic interferometer, developed by NPL, is used for the measurement of ultrasonic velocity

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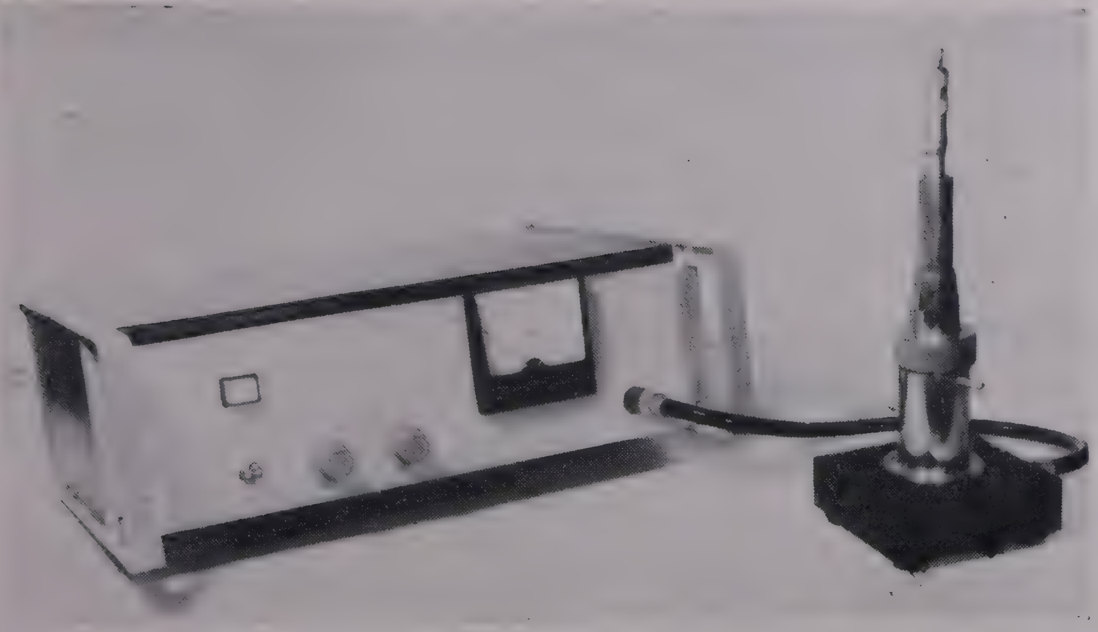
*Continued from 15 April 1972 issue of *CSIR News*.



Ultrasonic interferometer developed by NPL, New Delhi

in liquids with a high degree of accuracy over a wide range of temperatures. It is a compact, portable, neatly designed apparatus and gives trouble-free service. The measurement of ultrasonic velocity is based on the accurate determination of the wavelength in the medium.

The instrument consists of two parts: high frequency generator, and measuring cell. The generator produces the high frequency voltage required for operating a quartz crystal fixed at the bottom of the measuring cell. The HT current is fed to the output tube through a bridge network including a microammeter in such a way that changes in the plate current could be easily observed on the microammeter.

The ultrasonic waves produced by the quartz plate are reflected by a metallic plate kept parallel to the quartz plate producing standing waves in the medium. When the separation between the two plates is exactly a whole multiple of the sound wavelength (λ), the anode current of the generator reaches the maximum. If the distance of the reflector from the quartz plate is changed with the help of the micrometer screw, the anode current falls. It takes a maximum value again when the variation of distance is exactly one-half of the wavelength ($\lambda/2$), or a multiple of it.

On moving the reflector plate from one maximum current position to another, the half of wavelength can be measured with considerable accuracy. Since the frequency of vibration (f) of quartz plate is accurately known the value of velocity (v) in the medium is calculated using the relation $v=f\times\lambda$.

Provision has been made for circulating water at any desired temperature from a thermostatically controlled bath into a jacket around the measuring space to maintain the experimental liquid at a constant temperature.

The estimated production cost of the interferometer is Rs 3000 per piece. The cost of an equivalent imported unit is about $ 600. The device is being manufactured by Maheshwari Associates, New Delhi.

Cultivation and Survey of Medicinal Plants in Orissa Region

The Regional Research Laboratory (RRL), Bhubaneswar has recently taken up experimental cultivation and survey of medicinal and aromatic plants including phytochemical screening of the flora of Orissa region.

Orissa, with its diversified topography and varied climate, offers suitable environmental conditions for the cultivation of a number of commercially important medicinal and aromatic plants, both exotic and indigenous. A garden of medicinal plants has been set up at Bhubaneswar by the laboratory. Preliminary chemical investigations have shown encouraging results in respect of the following species introduced: *Anethum graveolens* (3.6% oils with 52.1% carvone); *Ammi majus* (0.42% xanthotoxin); *Solanum khasianum* (0.47% solasodine); *Mentha arvensis* (4.0% oil with 69.6% free menthol); *Cymbopogon winterianus* (1.86% oil); *C. citratus* (0.4% oil with 86% citral); and *C. martinii* (0.94% oil with 83.6% geraniol). The yields are comparable to those from the species growing elsewhere in India. *Mentha piperita*, found unsuitable in the coastal region, thrived well in the hill districts at 900 m altitude.

Orissa has rich and varied flora. About 43% of its land is under forest against a national average of 21%. Many of the forests are dense, undisturbed and unexplored. A number of important medicinal plants are found to grow abundantly in the forests. The important ones are *Strychnos nuxvomica*, *Hemidesmus indicus* (Indian Sarsaparilla), both of I.P. and B.P. standards; *Rauvolfia serpentina*; *Cymbopogon martini*; *Terminalia chebula*; *Terminalia belerica*; *Emblica officinalis*; *Bassia indica*; *Embelia robusta*; *Asparagus* spp.; and *Dioscorea* spp. A systematic survey of the availability of the medicinal plants in the State is being taken up.

Work on the biological evaluation of plants known to have medicinal properties is also planned. Selection of such plants in Simlipal Reserve Forests of Mayurbhanj district of Orissa has been taken up.

A herbarium of medicinal plants is being set up to incorporate the plant specimens, collected during survey, after their authentic identification. About 500 plant specimens have so far been classified and incorporated in the herbarium.

Phytochemical screening of the flora of Orissa is being done so as to find plants of new therapeutic value and also to find new sources of known therapeutic agents.

Metallurgical Coke from Sawang Washery Washed Coals

Considerable reserves of medium coking coal occur in East Bokaro coalfield. The coals obtainable from the seams in the area, however, need beneficiation before they could be charged into the coke oven in blends. Sawang washed coal on straight carbonization produced a slightly sub-standard coke, though the coke produced from Sawang washed coal alone was better in physical strength compared to the coke obtained from

Kathara washed coal. The Central Fuel Research Institute (CFRI), Dhanbad has carried out extensive tests in its high temperature carbonization pilot plant for exploring the possibilities of utilizing coals from Sawang Washery in the coking blends for various steel plants. It has been found that in one case up to 50% washed Sawang coal could be incorporated in the blend to produce standard metallurgical grade coke in admixture with washed coals of Dugda I and II washeries satisfying the stringent specifications of coke required for the Bokaro Steel Plant. The investigations point to the following possibilities of utilizing the Sawang washed coals in coking blends:

(1) Sawang washed coal could be blended up to 20% with 10% weakly coking Gidi-Bhurkunda washed coal and 70% prime coking coals (Dugda II/Bhojudih washed coals) for the production of satisfactory hard coke for blast furnaces up to 15 m^3 capacity if the constituent coals are crushed to a fineness of about 80% through 3 mm.

(2) When the constituent coals are crushed 100% through 3 mm, the proportion of Sawang washed coal could be increased to 27% in the blend containing 10% Gidi-Bhurkunda washed coal and 63% prime coking coal for the production of satisfactory ex-wharf hard coke.

(3) Even 25% weakly coking Gidi-Bhurkunda washed coal could be used in the blend along with 25% Sawang washed coal and 50% prime coking coals when the constituent coals are crushed to a fineness of about 100% through 3 mm and the blend is stamp-charged.

(4) Blending of even 15% Sawang washed coal with 40% Kathara washed coal and 45% prime coking coal is sufficient for the production of satisfactory hard coke when the constituent coals are crushed to a fineness of about 85% through 3 mm.

(5) Satisfactory hard coke for high capacity blast furnaces could be prepared from the blend containing 50% Sawang washed coal and 50% Dugda I and II washed coals (mixed in equal proportions) when the constituent coals are crushed to a fineness of about 85% through 3 mm.

Proceedings of the Second Symposium on Upper Mantle Project

The proceedings of the second symposium on Upper Mantle Project, sponsored by various organizations dealing with earth sciences and organized by the National Geophysical Research Institute (NGRI), Hyderabad from 28 to 31 December 1970, have been published by the Geophysics Research Board (GRB) and NGRI (GRB & NGRI Publication No. 11). The volume (royal 8vo, 592 pages) brings under one cover a major part of the contributions from India to the International Upper Mantle Project initiated by the International Council of Scientific Unions and International Union of Geodesy and Geophysics. It contains, besides invited addresses, fifty papers presented at the following six sessions: Regional gravity and magnetic surveys; Solid earth geophysics; Palaeomagnetism and continental drift; Combined geosurveys in Himalayas, Aravallis and Singhbhum belt and in Dharwars and Cuddapah basin; and Petrochemistry and geochronology.

An account of the proceedings of the symposium and NGRI's contributions to the upper mantle project has been published in *CSIR News*, **21** (1971), 25.

Ultimate Strength Design of Prestressed Concrete Sections in Bending

In its special publication (SP-4) issued in December 1971 the Cement Research Institute of India, New Delhi presents nomograms and charts for the ultimate strength design of prestressed concrete members in bending. A brief and critical review of the methods in vogue for the design of prestressed concrete members is included, and a method primarily based on the ultimate load conditions is proposed. This method is applicable to both reinforced and prestressed concrete beams including partially prestressed beams. The nomograms are based on the IS: 1343-1960 and would be useful in designing prestressed concrete beams.

PROGRESS REPORTS

NIO Annual Report: 1970-71

The annual report of the National Institute of Oceanography (NIO), Panaji for the year 1970-71, which has been published recently, records projectwise the progress of R & D work carried out in the various divisions and units of the institute under the following main areas: Physical Oceanography; Chemical Oceanography; Geological Oceanography and Biological Oceanography.

Beach erosion studies at 12 selected stations along the three main beaches of Goa, viz. Calangute-Candolim, Miramar-Caranzalem and Colva-Banaulim, were continued. The studies show the build-up of beach material, in general, from October through April, excepting in February when cuts in the beaches were noticed all along the coast. The beaches were under erosin from May onwards coinciding with the onset of monsoon. Vertical cuts were noticed especially in the foreshore region during monsoon months.

Analysis of data in regard to the distribution of phosphate in the southern Bay of Bengal on the basis of data collected during the International Indian Ocean Expedition was completed. A significant feature was the high phosphate content (>1 µg/l) off Madras, especially in the waters beyond the shelf extending up to about long. 84° 30′ E. The phosphate concentration was highest in the slope waters around 900 m.

Analysis for the depths of occurrence of oxygen maxima and minima in the north-east Indian Ocean (Bay of Bengal and Andaman Sea; lat. 0° and 26°N; long. 80-100°E) indicates that the oxygen-poor waters in the upper layers are common in the Bay of Bengal especially along the east coast of India during the south-west monsoon period. The seasonal upwellings along the east coast of India might be responsible for bringing up the oxygen-poor waters from the subsurface layer. In the northern Bay of Bengal, the oxygen content of both the surface and subsurface layers is found to be higher, probably due to freshwater discharge from the river; similarly, in the north equatorial current region also, the waters are rich in oxygen.

The planktonic foraminifera in the shelf sediments off the Arabian Sea and the Bay of Bengal have been studied. The occurrence of *Globigerina pachyderma*, a typical bipolar cold water fauna, was recorded in these waters. Twenty-five species of planktonic foraminiferans were identified; these include abundant forms like *Globigerina bulloides*, *Globigerinoides ruber*, *G. succulifer*, *Globoquadriva dutertrei*, *Globorotalia menardis* and *Pulleniatina obliqueloculata*. It has been observed that foraminiferal population decreases shorewards but increases progressively slopewards where much of the sediment is composed of calcium carbonate (skeletal and non-skeletal). One hundred and twenty species of benthic fauna have been identified from these sediments; their ecology is being worked out.

The preparation of plankton atlases, based on international zooplankton collection, was continued. The institute brought out IIOE Plankton Atlas: Vol. II, Fascicles 1 and 2. Volume II Fasc. 1 contains 11 maps showing the distribution of copepods and decapod larvae in the Indian Ocean. Volume II Fasc. 2 contains 10 maps showing the distribution of fish eggs and larvae in the Indian Ocean. The western Arabian Sea, the west coast of India and the northern Bay of Bengal are found to be extremely rich in plankton.

Unialgal cultures of 12 phytoplankton organisms were grown in enriched sea-water and the effect of three environmental factors, viz. salinity, light and nutrients, were investigated on their growth and rate of photosynthesis. Maximum photosynthesis of a large number of organisms was in the salinity range 10-25%.

Biological analysis of the samples collected during the cruises of INS Darshak from the Gulf of Bombay revealed that foraminifera are the major constituent of bottom fauna. Ninety-two species belonging to 40 genera were identified from the mud samples. Eight species were recorded for the first time in the Indian waters.

At the instance of the Bombay Municipal Corporation, the institute is investigating marine pollution problems and disposal of sewage and effluents into the sea surrounding the city.

PROCESSES & PRODUCTS READY FOR COMMERCIAL UTILIZATION

Potato Cold Storage Design

Proper design of the thermal insulation system contributes to the efficient and economic operation of cold storage space. The size of storage chamber depends on the total quantity of the material to be stored, the method of packing and clear space provided for movements. The Central Building Research Institute (CBRI), Roorkee has worked out designs for cold storages in general and potato cold storages in particular. The recommendations made by the institute are as follows:

(1) A storage space of 3·4 m³/tonne is most suitable for proper stacking and circulation of cold air.

(2) The height of the chamber should be 5-10 m for equal distribution and proper circulation of cold air.

(3) The passage between the rows of racks should not be less than 75 cm.

(4) The racks should be 20-25 cm away from the walls.

(5) A minimum gap of 30 cm should be provided between the ceiling and the top of the material.

The floor areas of potato cold storages for various heights and corresponding storage capacities have been worked out (Table 1). The recommended minimum thicknesses of insulation for potato cold storage are given in the Table 2.

TABLE 1—CAPACITY OF COLD STORAGE FOR DIFFERENT HEIGHTS OF POTATO COLD STORAGE

Floor area	Room height, *m*			
m²	4	6	8	10
	Quantity of product to be stored, *tonnes*			
50	64	96	128	160
100	128	192	256	320
150	192	288	384	480
200	256	384	512	640
250	320	480	640	800
300	384	576	768	960
350	448	672	896	1120
400	512	768	1014	1280
450	576	864	1142	1440
500	640	960	1270	1600

TABLE 2—RECOMMENDED MINIMUM THICKNESS OF INSULATION FOR POTATO COLD STORE BUILDING SECTION

Insulating material	Density *kg/m²*	Thickness, *cm*		
		roof	wall	floor
Cork	164·0	8·0	7·0	5·0
Fiber glass	26·5	7·5	7·0	5·0
Expanded polystyrene	18·4	7·0	7·0	5·0
Mineral wool	72·5	7·5	7·0	5·0
Foam concrete	320·0	18·0	15·0	10·0
Saw dust and rice husk	150·0	25·0	20·0	15·0

TABLE 3—DESIGN SPECIFICATION FOR POTATO COLD STORAGES OF DIFFERENT CAPACITIES

Quantity *tonnes*	Chamber height *m*	floor area *m²*	No. of rooms	Estimated refrigeration capacity *tonnes*
500	6	283	1	13·5
	10	170	1	12·5
1000	6	566	2	25·0
	10	340	1	23·0
2000	6	1132	4	48·0
	10	680	2	45·0

A slow speed compressor is better suited to Indian climatic conditions. The estimated refrigeration plant capacity is given in Table 3.

For further details of design and other precautions required in the construction of cold storages, interested parties may contact: The Director, Central Building Research Institute, Roorkee (U.P.).

Potassium Schoenite from Marine Mixed Salt

Potassium is an essential plant nutrient. The present annual requirement of potassium fertilizers in India is estimated at 2.5 lakh tonnes of K_2O.

Mixed salt : The only source of potassium fertilizers in India is bittern, a waste material from salt works. It is not economical to recover potassium fertilizer from bitterns directly as it contains only 2-2.5% potassium chloride. When bitterns are evaporated, mixed salt of high potassium chloride content is obtained. Field trials on the production of mixed salt have been successfully carried out by the Central Salt & Marine Chemicals Research Institute (CSMCRI), Bhavnagar in Saurashtra and Kutch (Gujarat) and Tuticorin area (Tamil Nadu). The trials are being extended to Vedaranyam area (Tamil Nadu) and other salt-producing regions of Maharashtra, Andhra Pradesh and Orissa. For every 100 tonnes of salt produced, 6-7 tonnes of mixed salt are obtained, and this is a suitable raw material for the manufacture of potassium fertilizers.

Potassium schoenite : Potassium fertilizers recoverable from mixed salt are potassium chloride, potassium schoenite ($K_2SO_4.MgSO_4.6H_2O$) and potassium sulphate. Processes have been developed by CSMCRI for the preparation of these potassium fertilizers from mixed salt. Recovery of potassium schoenite from mixed salt is preferable to making either potassium chloride or potassium sulphate since the capital investment and cost of production (rupees per tonne of K_2O) for potassium schoenite are the lowest, the values being: Rs 25 00 960 for potassium chloride; Rs 16 00 700 for potassium sulphate; and Rs 5 30 390 for potassium schoenite. Besides, it is cheaper to import potassium chloride rather than potassium sulphate: cost per unit K_2O is Rs 5 for potassium schoenite and Rs 8 for potassium sulphate.

The process for recovering potassium schoenite is, in principle, as follows :

The composition of the mixed salt obtained from sea bitterns is : potassium chloride, 18-20; magnesium sulphate, 30-35; sodium chloride, 15-20; and magnesium chloride, 6-8%; the percentage of potassium chloride and magnesium sulphate is in the ratio required for the formation of schoenite. However, the presence of sodium chloride hinders the direct formation of schoenite and hence it is eliminated by flotation, using octadecylamine acetate and highly sulphonated castor oil. The floated product (containing potassium chloride and magnesium sulphate) on treatment with water under constant agitation yields schoenite.

A provisional cost estimate for the manufacture of 3000 tonnes of potassium schoenite per annum has been worked out. The plant, estimated to cost Rs 3.5 lakhs, can process annually 6300 tonnes of mixed salt and is suitable for medium size salt works manufacturing 75 000-1 00 000 tonnes of salt per annum.

Potassium schoenite has been used as a potassic fertilizer in western countries. It can replace imported potassium sulphate in fertilizer mixtures under certain conditions. Besides, the magnesium present in the potassium schoenite is a secondary essential plant nutrient and helps in the assimilation of other nutrients present in the fertilizers.

Further particulars may be obtained from : The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

CSIR SUPPORT TO RESEARCH

Completed Schemes

Role of Endotoxin in Typhoid Encephalopathy

Encephalopathy usually occurs in a small proportion of cases of typhoid fever and no definite pathogenesis is known. A study was undertaken by Dr A. K. Nag at the Maulana Azad Medical College, New Delhi, under a CSIR research fellowship, to determine the role of the endotoxin in the production of typhoid encephalopathy.

Forty-one cases of suspected typhoid encephalopathy were studied over a period of 2½ years. The clinical features and laboratory tests, e.g. blood culture, clot culture, Widal reaction, urine and stool culture, cytology and biochemistry of cerebrospinal fluid, were investigated in all the cases. Only six cases (14.6%) satisfied the criteria of typhoid encephalopathy.

The first phase of the study related to the isolation, purification and characterization of the Boivin's antigen and determination of LD_{50} in mice and 10-day old chick embryo. It has been demonstrated that the normal human serum could detoxify the lethal effect of the endotoxin on chick embryo and calcium chloride could uncouple this effect; but heating the inactive endotoxin-normal human serum complex at 60°C for 1 hr could not uncouple. Untreated whole serum of six selected typhoid encephalopathy patients had no lethal effect on 10-day old chick embryo, whereas this serum incubated with calcium chloride could kill the embryos within 18 hr of injection. It was also found that sera of patients in the second week and third week of fever, incubated with calcium chloride, could kill 10-day old chick embryo, but sera of patients in the first week of fever had no lethal effect under similar experimental conditions.

The second phase of the study was concerned with the effect of *Salmonella typhi* endotoxin on the metabolism of brain in a few experimental animals. When administered *in vivo* the endotoxin could depress succinic dehydrogenase activity of the mouse brain to about one-half of the normal activity. The ratio of exogenous to endogenous activity of succinic dehydrogenase was found to decrease from the normal value of 2.7 to the *in vivo* value of 1.

A similar effect was observed *in vitro*. Glucose-6-phosphate dehydrogenase activities of normal and endotoxin-treated mouse brain were also studied. No significant difference in the rate of production of reduced coenzyme triphosphopyridine nucleotide was observed when the endotoxin was injected intraperitoneally in mice (normal rate of production of reduced coenzyme triphosphopyridine nucleotide was 9·53 units/min/g of brain homogenate). On the other hand, *in vitro*, there was significant depression of the activity of glucose-6-phosphate dehydrogenase at a higher concentration of the endotoxin.

Using the trypan blue technique of Goldman, evidence was obtained for the damage of the blood-brain barrier when endotoxin was injected 24 hr after the first exposure of the mice by the same antigen.

On the basis of the presence of *S. typhi* endotoxin in the circulation of these patients in the later part of the second week and earlier part of the third week of the disease, it has been postulated that during this period, when there is a great deal of antibody response causing enhanced phagocytosis of *S. typhi*, endotoxin is released into the circulation. It has been demonstrated by Skarnes that alpha-globulin esterase fraction of normal human serum could detoxify the Boivin's antigen of *Salmonella enteritidis*.

Most of the endotoxin is bound by this serum fraction forming an inactive complex; only the unbound endotoxin produces harmful effects on the host already sensitized by this endotoxin during the first week of disease in which bacteremia persisted. In the later part of the second week or early part of the third week of the disease, this unbound excess endotoxin might damage the blood-brain barrier leading to the leakage of the macromolecular toxins in the cerebrospinal fluid.

On the basis of the observation that succinic dehydrogenase activity, both exogenous and endogenous, is reduced it is concluded that Boivin's antigen of *S. typhi* could depress succinic dehydrogenase which is an important enzyme in the respiration of brain cells. The lowering of the ratio of exogenous to endogenous activity of this enzyme to 1 from the normal 2·7 suggests that the reserve capacity for the utilization of glucose by the brain cells is lost and that the cells function at the basal endogenous level. The activity of glucose-6-phosphate dehydrogenase was unaffected when this endotoxin was injected intraperitoneally *in vivo* at a dose level which affected the succinic dehydrogenase activity; but the addition of the endotoxin to the normal brain homogenate at a higher concentration decreased the activity of glucose-6-phosphate dehydrogenase. The results lead to the postulation that *in vivo* a small amount of this macromolecular endotoxin may cross the blood-brain barrier and depress the succinic dehydrogenase activity but not the glucose-6-phosphate dehydrogenase activity. When the damage to the blood-brain barrier is more in severe cases, there might be a greater concentration of this endotoxin causing depression of the activity of the latter enzyme and leading to coma.

Conjugated Hydrogenation and Solvent Hydrogenation of Seed Fats

Conjugated hydrogenation of triglyceride oil containing non-conjugated triene acids, viz. linseed oil [fatty acid composition (%): linolenic 50·2, linoleic 11·5, oleic 28·0, and saturated acids 10·3] has been investigated by Dr A. K. Basu, a CSIR research fellow, working under the supervision of Prof. M. M. Chakrabarty at the Department of Applied Chemistry, University of Calcutta, Calcutta. The effect of hydrogen donors, such as primary and secondary alcohols, on the rate and selectivity characteristics under different experimental conditions of temperature, catalyst concentration, catalyst type and amount of hydrogen donor was studied. Isopropanol, in general, gives a more accelerated rate and a greater degree of reduction but is less selective than ethanol when linseed oil is treated at 250°C with 2% Rufert nickel catalyst (optimum catalyst level) and hydrogen donors present in twice the stoichiometric amount. Decrease in the catalyst concentration from 2% to 1% in the case of isopropanol lowers the rate and the degree of hydrogenation sufficiently and an enhanced selectivity almost similar to that in the case of ethanol is noted. But the rate and the degree of reduction in the case of ethanol remain almost unchanged and similar selectivity characteristics are exhibited. The rate of hydrogenation with a primary alcohol like ethyl alcohol is less influenced by its amount and nearly a similar degree of reduction is obtained when both the stoichiometric amount and double the amount of ethanol are used. On the other hand, in the case of a secondary alcohol like isopropyl alcohol, these characteristics are dependent more on the amount of the hydrogen donor. Isopropanol in stoichiometric amount gives greater selectivity compared to that obtained when double the amount is used. Thus, isopropanol in twice the stoichiometric amount with 1% and 2% Rufert nickel at 250°C reduces the iodine value of linseed oil from 180·1 to 18·9 and 1·5 respectively in 6 hr; ethanol under similar conditions reduces the iodine value to 60·5 and 59·2. When stoichiometric amounts of ethanol and isopropanol are used (at 250°C with 2% of the catalyst) the iodine value of linseed oil is reduced to 61·2 and 42·5 respectively in 6 hr.

Lowering of temperature retards both the rate and the degree of hydrogenation in the case of ethanol. With isopropanol, lowering of temperature reduces the rate in the initial stages of the reaction, but almost a similar rate and degree of hydrogenation are obtained as the reaction progresses.

The extent of hydrogenation is largely dependent on the nature of the catalyst, particularly in the case of a primary alcohol. There is an enormous increase in the rate and degree of ultimate reduction with ethanol when Raney nickel (2%) is used, compared to that obtained in the case of Rufert nickel. Isopropanol, however, shows a similar trend of increased rate with Raney nickel at the commencement of the reaction, but later the reaction is slower compared to that with Rufert nickel, although the degree of ultimate reduction is the same.

PATENTS ACCEPTED

Indian Pat. 127236

A process for the production of a fungal acid protease for use, e.g. as a bating agent in leather manufacture

A. Thangamani, R. K. Ghosh & P. K. Goswami

IIEM, Calcutta

The invention covered by the patent relates to a process for the production of an acid protease having optimum activity in the pH range 3-4 from the culture filtrate of the mould *Penicillium janthinellum* grown in liquid medium in submerged culture.

Acid proteases have many uses, e.g. as acid bates in leather manufacture and as aids to gastric digestive of proteins. The present invention describes the use of the fungal protease as a new bating agent in leather manufacture. Proteases presently used in bating act at pH 8, and therefore, after bating, the petts have to be pickled with salt at pH 2.8-3.0 before they are ready for tanning. It would be advantageous to use an acid protease for bating, as the additional step of pickling can be eliminated. In preliminary tests, goat skin was bated with the fungal protease at pH 3.0 in the presence of 5% common salt and was then tanned without pickling. The test was successful.

For growing the mould, the nitrogen source can be a mixture of ammonium sulphate and potassium nitrate or just urea; and the carbon source is glucose. Both the nitrogen and the carbon sources can be replaced by wheat bran or rice bran.

Indian Pat. 125406

Organic depolarizer batteries

P. B. Mathur, R. Balasubramanian &
N. Muniyandi
CECRI, Karaikudi

Conventional depolarizer materials like lead dioxide, manganese dioxide, and mercury oxide used in battery cathodes do not possess high ampere hour capacity per unit weight. Hence appreciably large quantities of these materials are required per unit power output of the batteries. Several organic compounds consisting of readily reducible functional groups are capable of undergoing as many as 12-electron transfer, whereas the above mentioned depolarizer materials are capable of undergoing only 2-electron transfer. Hence these organic substances can deliver several times more ampere hour output capacity per gram of the substance in comparison with the conventional battery depolarizer materials.

The invention covered by the patent relates to the development of high energy battery systems in which organic depolarizer materials are used as cathode substances which possess 0.8 to 1.0 amp hr per gram of the material efficiency.

The salient features of the organic batteries are as follows:

(1) They are capable of continuous discharge at low and high current drains.

(2) They operate within a very narrow range of voltages, viz. 1.15V to 0.95V, even on continuous discharge for weeks together. This is a significant advantage over the conventional dry cells which show a large voltage drop, from 1.5V to 0.95V, during discharge.

(3) They have a shelf-life of over 5 years under unactivated conditions.

(4) They can be activated in less than a minute when required for use.

Because of the high power density characteristic, high current drain capability, long shelf-life, narrow range of operational voltage and quick activation, these battery systems have immense potentiality for defence and civilian applications and can be good substitutes for dry cells in many equipments. These batteries can compete in cost with many of the special and conventional battery systems.

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134168: A surface sizing composition for the production of greaseproof paper, C. N. Saikia, N. C. Nandi, S. B. Lodh & M. S. Iyengar — RRL Jorhat.

134170: A strain gauge pressure transducer, V. R. Singh & R. Parshad — NPL, New Delhi.

134546: Improvements in or relating to chemical refining of graphite (natural or beneficiated) having 1% mineral matter, R. L. Seth, A. Biswas & S. Ghose — CFRI, Dhanbad.

134641: A device for warming and cooling, L. Singh & A. N. Kotasthane — NCL, Poona.

134716: A photo-emulsion for printed circuits or surfaces such as plastics, glass sheets and instrument panels, Surinder Singh — NPL, New Delhi.

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134772: A process for the recovery of alkali from aqueous solutions containing alkali carbonates, hydroxides, phosphates, silicates and aluminates, S. B. Kanungo & B. R. Sant — RRL, Bhubaneswar.

134835: Device for increasing the speed of bicycles, S. K. Rao, S. C. Sarmah, U. Chaudhury & M. S. Iyengar — RRL, Jorhat.

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122025 : New support material for gas chromatography, K. L. Mallik & R. Moolchandra—IIP, Dehra Dun.

122568 : A distillation apparatus, F. Kiss—NPL, New Delhi.

122997: An apparatus for recording wind direction, V. R. Bhave — CPHERI, Nagpur.

123139: Improvements in or relating to magnet and electro-ceramics, C. V. Ganapathy, G. Govindaswamy, S. M Khular, S. S. Hanspal & K. Narayanan — NPL, New Delhi.

123231: Improvements in the process for the preparation of 2,4-dichlorophenoxyacetic acid (2,4-D), P. A. Swaroop, D. P. Agrawal & R. Vaidyeswaran — RRL, Hyderabad.

123289: Improvements in or relating to the solution for stripping nickel deposits, N. V. Parthasaradhy & S. Sreeveeraraghavan — CECRI, Karaikudi.

123290: Improvements in or relating to the electrolytic production of sodium perchlorate, H.V.K. Udupa and others — CECRI, Karaikudi.

123365: Bonding PVC sheets to leather to produce finished leather, P. S. Venkatachalam & J. K. Khanna — CLRI, Madras.

123527: A distillation flask, F. Kiss — NPL, New Delhi.

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Research Utilization in Salt Industry: Get-together at CSMCRI

A get-together of research workers, salt manufacturers and planners associated with the development of salt industry was organized by the Central Salt & Marine Chemicals Research Institute (CSMCRI), Bhavnagar at the institute on 3 February 1972. In his presidential address, Shri S. K. Vakil, of the Saurashtra Chemicals, Porbandar, said that the salt industry should utilize the improved methods available now for increased production of salt and recovery of valuable marine chemicals. He suggested that the institute may undertake fundamental research work aimed at the elimination of ammonia in the manufacture of soda ash, which can reduce manufacturing costs. The institute's work relating to the improvement in the quality of salt, manufacture of high purity and fortified salt, and recovery of byproducts from the end liquor was reviewed by various workers in their respective areas of work.

Manufacture of salt

The session on salt opened with a lecture on the layout of a salt farm (M. H. Jadhav), which provided information on both the climatological and physical factors which determine the suitability of a location and influence the design and layout of salt works. A suggestion was put forth for working the crystallizers in series to improve the quality and quantity of salt.

High purity and fortified salts

The talk on the processes of manufacture of high purity salt and fortification of salt to obtain calcium, and iron-fortified salts and iodized salt (G. C. Jain & R. B. Bhatt) revealed the suitability of these salts as a cheap base for commonly needed nutrients. The submersion process for iodization of salt by the use of calcium iodate as iodizing agent leads to uniform distribution of iodine to the desired level, and this iodizing agent is more stable than potassium iodide so far being used in the process.

Mechanization in salt industry

The talk on mechanical harvesting and handling of salt (A. S. Kane) dealt with partial mechanization of the salt harvesting operation with the equipment designed at the institute. He explained that only scrapping, loosening and washing of salt could be accomplished under the present operational conditions of Indian Salt Works which can result in 25-35% savings in labour cost. For accelerating the loading rate for shipments of salt, the use of silos and heavy duty long conveyors was suggested.

Upgrading salt using washeries

The session on salt concluded with a talk on the washing of salt (M. P. Bhatt). The work done at CSMCRI in this field was reviewed with special reference to the dispersed washing column for washing Runn salt. The washery units could be preferentially installed at the source of manufacture of salt to achieve economies.

Marine chemicals

The second session was devoted to the recovery of marine chemicals, and began with a talk (G. D. Bhatt) on the recovery of mixed salt, a rich source for potassium chemicals, by solar evaporation. A process developed at CSMCRI for separating mixed salt in a lower density range 34·5°-36·5° Be′ instead of in the region 36°-38·0° Be′ was described. The speaker advocated the use of a dye for quicker evaporation of bittern.

Potassium chloride and potash alum from mixed salt

The advantages of the process developed for the recovery of potassium chloride from mixed salt were dealt with by K. Seshadri who said that a commercial plant is under development at Kandla. Another process developed for the manufacture of potash alum by the reaction of solid mixed salt with aluminium sulphate solution at 100°C and by cooling the hot filtrate to obtain pure crystalline potash alum was described.

Potassium schoenite from mixed salt

A process for obtaining potassium schoenite, a double sulphate of potassium and magnesium, by flotation technique was described in a talk by G. T. Gadre. Potassium schoenite is used as a potassium fertilizer in western countries and can be a good substitute for imported potassium sulphate in fertilizer mixtures. The speaker informed that a plant using the institute's know-how has gone on stream at Tuticorin under a private sector industrial unit. The acceptability of this chemical as a fertilizer has been advocated (K. K. Bokil) following trials at 28 agricultural research stations in the country. The Government of India have provisionally approved the inclusion of this chemical as a potassium fertilizer in the Fertilizer Control Order.

Magnesium chemicals

The talk on the recovery of various magnesium chemicals (M. C. Vaidya) dealt with the processes developed by CSMCRI for recovery of light and heavy basic magnesium carbonate, magnesium trisilicate and pharmaceutical grade magnesium hydroxide from bitterns.

Bromine from bittern

Reviewing the history, occurrence, uses and the manufacture of bromine abroad, S. D. Gomkale described briefly the process developed for the recovery of this chemical from sea bittern with particular reference to the demonstration unit (50 kg/hr capacity) installed at the Experimental Salt Farm. The blowing-out process for the recovery of bromine from sea-water was also described.

The economics of the recovery of various chemicals from bitterns and the possibility of the setting up of marine chemical complexes around large salt works or a group of salt works was discussed in a talk (A. V. Rao) with special reference to salt works producing more than one lakh tonnes of salt annually.

The commercial plant put up by Chem-O-Ocean Industries, Navlakhi for the recovery of bromine from sea bittern using the institute's know-how is expected to start production shortly, as revealed by a representative from the firm.

A major outcome of the get-together was the setting up of a 'task force' comprising representatives of salt industry, the Salt Department, the National Research Development Corporation of India, experts from salt based industry and scientists from the institute, which will meet periodically to discuss the problems of the salt industry and identify the research problems for investigation by the institute. It will also endeavour to establish and develop marine chemical complexes; to improve the quality of salt, and to examine the possibilities of introducing mechanization in salt industry.

Standardization in Foundries: Foundry Convention and Seminar at NML

The twenty-second Annual Foundry Convention and a seminar on Standardization in Foundries, organized jointly by the Institute of Indian Foundrymen, the National Metallurgical Laboratory (NML), Jamshedpur and the Indian Standards Institution (ISI), were held at NML, Jamshedpur from 26 to 28 February 1972. The object of the convention and the seminar was to provide a forum for the foundry technologists, metallurgists and scientists to discuss the present status of the foundry technology in India and the benefits derived by the foundry industry by the introduction of standardization, and utilization of the results of recent researches aimed at import substitution and export promotion.

The convention and the seminar were attended by about 200 delegates from foundries, government departments, and research institutions.

Three papers on standardization in foundries were presented and discussed at the seminar. B. S. Krishnamachar and R. K. Srivastava of ISI, New Delhi, described the standards developed and issued in respect of pattern equipment, moulding boxes, pattern plates and pins, foundry tools and accessories, moulding sands, cupola designs and ferrous and non-ferrous castings.

P. K. Sandell and P. P. Mohla (Delhi Cloth Mills Ltd, Delhi) reviewed the developments in the field of melting, moulding, core-making and various other fields where existing Indian standards were sufficient to cover developments of new foundry processes and/or raw materials, and also where new Indian standards would be formulated.

A. K. Chatterjee (Binani Metal Works, Howrah) dealt with standardization in non-ferrous foundries.

Fourteen papers, including three from scientists from NML, on topics of interest to the foundry industry were presented and discussed at the three technical sessions of the convention.

R. K. Mahanty, C. S. Sivaramakrishnan, Manjit Singh and Rajendra Kumar (NML, Jamshedpur), in their paper 'Impact of modern metallurgical concepts in metal casting', critically evaluated some of the more recent concepts concerning the quality of the liquid metals.

The impact of new processes and products on the Indian foundry industry was discussed by Y. K. Subrahmanya of the Cooper Engineering Ltd, Satara. Future foundry developments in India might lay stress on electric melting, mechanization, use of quicker methods of production from the point of view of higher productivity, reclamation of used sand, pollution control, etc.

B. V. M. Rao and K. G. Keshava Murthy (Durgapur Steel Plant, Durgapur) made an analysis of the Russian fluid sand process in which sand having a thick cream-like consistency was prepared by an ingenious technique, and indicated that the process could be adopted for making the ingot mould castings at the Bokaro Steel Plant.

In their paper entitled 'Development of hot- and cold-setting binders from cashewnut shell oil liquid', C. R. Murthy, K. A. Gandhi, R. L. Kumar and A. K. Kar (IIT, Kharagpur) dealt with baked properties of polymerized cashewnut shell oil liquid alone or with boiled linseed oil under various conditions.

In his paper entitled 'Optimization of the properties of liquid quick hardening mixtures', B. K. Dhindaw (IIT, Kharagpur) mentioned that the properties of the moulding material could be optimized with mathematical designing of the experiments.

R. R. Dash, G. G. Nair, R. K. Dubey and P. K. Gupte (NML, Jamshedpur) dealt with the effects, on the structural and mechanical properties, of the addition of Cr, Mn, Ti and small amounts of Mo (singly or in combination) and V to white cast iron.

The continuous casting method which is being employed for manufacturing ferrous and non-ferrous metals and alloys formed the subject of a paper presented by D. C. Galada of the Galada Continuous Casting Systems, Madras.

The paper 'Sodium silicate-bonded sands' by Ashimesh Dutt, G. N. Rao and P. K. Gupte (NML, Jamshedpur) dealt with the basic concepts of the various processes using sodium silicate binder, their advantages and disadvantages and the present state of understanding and application by the foundry industry.

.N. Seshadri, K. V. Prabhakar and M. N. Srinivasan (Indian Institute of Science, Bangalore) and M. R. Seshadri (IIT, Madras) described the results of studies on the influence of insulated type die coatings on the solidification times of plate and cylindrical shaped Al 4·5% copper (LM 11) test castings cast in cast iron dies of 1/2 in., 3/4 in. and 1 in.

The data obtained on the microstructures and mechanical properties of aluminium bronze, brass and admiralty gun-metal castings in shell moulds having different backing materials and thickness were reported by A. Jayaraman, H. Md Roshan and V. Panchanathan (IIT, Madras).

Pointing out that a system of inspection control, known as stage inspection and quality control, would increase the productivity in foundries, K. G. Udupa of the Bhilai Steel Plant, Bhilai, discussed how the system has worked at this plant, which has the largest foundry in the country.

M. R. Gajapathy (Lasco Steels Ltd, Doddampathy) dealt with the process aids to increase the production capacity in a steel foundry.

The last paper of the convention, by K. C. Choudhuri and A. K. Bhattacharyya of the Research, Designs & Standards Organization, Lucknow, dealt with the methods of study undertaken by RDSO for designing appropriate running and gating systems which could play a significant role in minimizing the rejections of castings in non-ferrous foundries.

Import Substitution and Invention Awards*

Distillation Apparatus for *Attars* and Perfumed Waters

A variety of essential oils, *attars* and perfumed waters are required by the perfumery and pharmaceutical industry. They are most commonly obtained by the distillation of various naturally occurring flowers, seeds, herbs, etc. The main drawback of the processes currently being used is the deterioration in the quality of the products owing to over-heating of the distillate. Another common drawback is incomplete condensation of vapours leading to the loss of valuable products.

A new distillation unit developed by the National Botanic Gardens (NBG), Lucknow overcomes these drawbacks to a large extent. The unit has a provision for cooling the condensate as soon as it is formed, thus preventing its over-heating. A convenient arrangement has been made for separating the oil from water and for the continuous removal of perfumed water to a receiver by a siphoning arrangement. In the laboratory scale model fabricated at NBG provision has also been made for readily measuring the quantity of oil produced at the end of distillation. This feature makes the apparatus particularly suitable for raw material evaluation and quality control work.

The estimated cost of the laboratory model glass apparatus is about Rs 300. Many essential oil producing countries like France, Singapore and Iran have shown considerable interest in the apparatus. The apparatus can be made of metal also to suit the local requirement of the industries.

Surgical Sutures from Mammalian Intestines

A strand, cord or fibre used to sew together tissues, nerves or blood vessels is referred to as a 'suture'; when used to ligate or 'tie off' a blood vessel to prevent haemorrhage it is known as a 'ligature'. The suture or ligature is also called 'catgut'. There are two types of sutures, viz. absorbable and non-absorbable. Materials like stainless steel wires, horse tail hairs, silk and cotton threads, and synthetic fibres fall under the non-absorbable type. The suture, usually made out of the submucosa or serosa layers of the small intestines of herbivorous animals such as sheep, goat, cattle, horse and mule, is an absorbable material. The absorbable suture is further divided into two categories —plain and chromic. The plain suture gets metabolized in a period of 2 to 7 days while the chromic suture stays for a much longer period in the body.

A process for making absorbable suture using the small intestines of sheep and goat, which are indigenously available in abundance, has been developed by the Central Leather Research Institute (CLRI), Madras. The process essentially consists of the following operations.

After the animal is slaughtered, the intestine is removed from the viscera, care being taken that no holes or cuts are made during this operation. The intestines thus collected are subjected to a preliminary cleaning operation either manually or mechanically. The cleaned intestines are salted and preserved for export as sausage casings. The same material is used for the manufacture of absorbable sutures.

The salted casings are further subjected to a series of cleaning operations using aqueous baths of various chemicals to make them free from unwanted materials like non-collagenous proteins, fats, polysaccharides, etc., which are still associated with them. The cleaned collagen-rich casings thus obtained, which are tubular in form, are sliced longitudinally into ribbons with the help of a special knife. The ribbons are sorted out for the plain and chromic sutures. The ribbons for the plain stock are bleached in an alkaline bath of hydrogen peroxide for varying periods till milk white and the ones for the chromic sutures are chromicized in an acidic bath of an aqueous solution of chromium sulphate. The bleached and chromicized ribbons for the plain and chromic sutures respectively are washed in running water to make them free of soluble salts and then spun into threads or cords using one, two, three or more numbers of ribbons depending on the final thickness of the suture desired. The twist should be uniform over the entire length of the cord and should not be overtwisted or undertwisted. The twisted cords are dried under tension in a temperature and humidity-controlled room for ensuring uniform drying. The dried cords are polished with the help of a polishing machine, gauged and cut into desired lengths. The cut lengths are made into loops and put into glass ampoules along with a sterilizing fluid and sealed aseptically.

The sutures prepared as above have been comprehensively tested in the laboratory, many health laboratories in the country and the Twyford Laboratories, London for *in vivo* and bacteriological tests and for physical properties, and have satisfactorily passed all the British

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*Continued from 30 April 1972 issue of *CSIR News*.

Pharmacopoeia standards. On the successful completion of these tests the process was patented in India and assigned to the National Research Development Corporation of India, New Delhi.

India's annual requirements of surgical sutures, which is also a strategic material for the defence forces, are estimated at 3 00 000 dozen ampoules. A sizable part of the requirements of surgical sutures, valued at Rs 8 to 10 million a year, is imported.

The know-how developed by CLRI has been released to J. L. Morison Son and Jones (India) Ltd for commercial exploitation, and the firm has started production at its newly constructed factory at Bangalore.

Drapemeter : BTRA

The Bombay Textile Research Association (BTRA), Bombay has developed an instrument for the rapid evaluation of the draping quality of fabrics. Known as BTRA drapemeter, it measures the 'drape coefficient' of fabrics on the same scale as other modern instruments developed elsewhere—the FRL drapemeter (USA) and the Cusick drapemeter (UK). A circular fabric specimen (25 cm diam) is sandwiched between a pair of plates 12·5 cm diam) and allowed to hang down in folds. A planar projection of the pattern formed by the draped sample is recorded on high-speed ammonia paper placed immediately below, with the help of a mercury vapour lamp positioned above. The print is developed in ammonia and the drape pattern cut out and the drape area evaluated by weighing.

Drapemeter developed by BTRA, Bombay

The advantages of the instrument are as follows:

(1) The simple construction avoids the use of complicated optical-electronic systems without impairing speed or efficiency.

(2) The diagram is automatically printed and the area evaluated gravmetrically; thus, manual tracing and planimetric measurements are unnecessary.

(3) The instrument could be fabricated in mill workshops at about one-tenth the cost of imported equipment.

A systematic study of the structural and chemical variables that control fabric drape is of recent interest, and the drapemeter is a useful addition to the laboratory equipment for research and development in composite mills.

PROGRESS REPORTS

CPHERI Annual Report : 1971

One hundred and sixty-five research projects were investigated during 1971 by the Central Public Health Engineering Research Institute (CPHERI), Nagpur and its eight zonal laboratories in the following areas: water treatment, sewage, industrial wastes, air pollution and industrial hygiene, microbiology, engineering, solid waste disposal, water pollution surveillance, rural sanitation, and instrumentation, according to its annual report published recently. Forty-eight projects were completed during the year.

The institute continued to function as a WHO regional reference centre on air pollution and as a collaborating institute of the WHO international reference centre on community water supply and waste disposal.

The institute's know-how on defluoridation of water is being made available to the Government of Tanzania. A report based on on-site investigations in Arusha (north Tanzania) along with recommendations for installing a defluoridation plant using Defloron-2 (developed by the institute) was submitted. The plant, consisting of a pressure type mild steel shell with all the accessories, has been designed by the institute. The average fluoride concentration in the treated water would be 0·6-0·8 mg/litre, and cost of treating 1 m³ of water would be about Re 0.50.

In the field of sewage treatment, work on the low-cost waste treatment methods, viz. stabilization pond, aerated lagoon and 'Pasveer-type' oxidation ditch, was continued. The efficacy and economics of waste water treatment by the use of biological discs is being studied on a pilot plant consisting of 50 discs (8 ft diam).

In order to make optimum use of nutrients present in sewage, CPHERI laboratories analysed sewage samples from eight big cities in the country in three seasons for the major plant nutrients, viz. nitrogen, phosphorus and potassium, and alkyl benzene sulphonate. A survey of sewage farm practices in the country and the associated health hazards has been carried out.

At the instance of the Indian Petrochemical Corporation Ltd (IPCL) the institute worked out a method for treating wastes from their Aromatics Project at Baroda. The method is based on studies carried out with simulated waste. A report containing five alternative flowsheets along with cost estimates and land requirements was furnished to IPCL. An important study aimed at the utilization of industrial waste concerns the recovery of protein-rich yeast, *Torula utilis*, from prehydrolysate liquor of rayon pulp wastes. A pilot plant for producing yeast on a semi-large scale is being set up at the factory site.

Assistance was rendered to six industries by way of assessing the atmospheric pollution caused by industrial emissions; remedial measures were suggested.

The improved technique, developed by CPHERI, for concentration and quantitation of small amounts of viruses from large volumes of water and waste water has been found to be suitable for monitoring sewage and effluents from sewage treatment plant.

Country-wide collection of data on the quality and quantity of refuse covering all variations of climatic conditions and dietary habits is being made under a project supported by PL 480 funds. Data on the cost of transport and disposal of refuse from cities are also being collected.

A new division, Water Pollution Surveillance, was created for planning and undertaking exploratory surveys of the chemical, biological and bacteriological characteristics of large rivers and water bodies. This information will be useful in the planning and design of water supply and treatment schemes and in judging the adequacy and suitability of waters necessary for industrial enterprises. A model study is proposed to be started on Gomti river in collaboration with the Local-Self Government Engineering Department of Uttar Pradesh.

Three patents filed during the year relate to: (i) synthetic polyanionic coagulant aid CA-11; (ii) coagulant aid CA-15; and (iii) membrane filter. Thirty-four research papers were published and 30 investigation reports were brought out by the institute. A conference on 'Research and Development in Public Health Engineering in India', organized by the institute, identified the areas of R & D in the various branches of public health engineering and indicated priorities.

PROCESSES & PRODUCTS READY FOR COMMERCIAL UTILIZATION

Electrochemical Marking of Metals

This method is of considerable use for transferring letters, designs and numbers to metals so that metal articles of industry and commerce are marked for the purpose of identification, certification of quality and for advertisement. The method has the advantages of speed, clarity, permanence, ease of production and of causing negligible damage to the underlying metals.

The know-how and equipment required for elctrochemical marking of metals and metallic articles is not available in the country and will have to be imported, involving foreign exchange.

Process: With a view to developing know-how and to designing equipment required for electrochemical marking of the metals, investigations were undertaken by the Central Electrochemical Research Institute (CECRI), Karaikudi. The work involved: (i) design of a suitable pad with electrodes to hold electrolytes and capable of carrying the required density of current; (ii) use of a suitable combination of electrolytes and additives to effect the rapid etch and/or deposit of the metal; and (iii) design of a suitable stencilling device.

The process has been studied on a laboratory scale. Metals marked by the method developed by CECRI have been approved by several firms.

Sodium chloride, boric acid, sodium hydroxide, potassium dichromate, benzoic acid, polyvinyl alcohol, ferric chloride and tartaric acid are the main raw materials needed in the process.

The essential items of plant and machinery are: transformer for ac markings, rectifier for dc markings, ac or dc meter, electrode holder, and an electrical tuning device.

It would be possible by the use of the above equipment to carry out marking operations over an area of 10-20 cm² of the metal.

The total capital outlay for putting up a metal marking unit capable of producing 1 50 000 markings per year has been estimated at Rs 5700. The cost of marking an area of 20 cm² has been estimated at about 11 paise.

Further particulars may be obtained from: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

Copper Plating of Stainless Steel

Because of their non-corrodible nature stainless steel utensils are preferred to copper and brass vessels. Other advantages of stainless steel vessels are that they take mirror finish and retain it, and periodical tinning of the surfaces is not required unlike in the case of copper and brass vessels. In spite of these advantages stainless steel utensils are poor thermal conductors of heat, and an appreciable amount of heat is lost by radiation. These drawbacks can be easily eliminated if the surface coming directly in contact with the flame or hot plate is plated with copper to a thickness of 0·02 in.

The conventional method of plating copper on stainless steel consists in giving a nickel strike from Wood's nickel bath. The method involves the use of nickel anode and nickel salts which are costly.

Process: The Central Electrochemical Research Institute (CECRI), Karaikudi, has developed a process (Indian Pat. 113473) of direct plating of copper on stainless steel from an acidic copper chloride bath (this being a strike bath), followed by a copper buildup from the conventional acid copper sulphate bath. The direct plating of copper on stainless steel eliminates the use of nickel coating between the substrate and thick copper coating.

The process has been studied on a laboratory scale, and investigations have been carried out using 300 litres of bath capable of plating 10-12 vessels at a time. The product meets IS specification.

The main items of plant and machinery required are: MS tank, MS tank (PVC-lined), copper bushbars and clamps, heaters, rectifiers, air compressor, buffing wheel, grinding wheel and filter unit.

Sodium hydroxide, sodium carbonate, hydrochloric acid, cupric chloride, sulphuric acid, copper sulphate, nitric acid, anodes, and paraffin wax are the raw materials required. All are available indigenously.

The total capital outlay for putting up a unit capable of processing an area of 7500 cm² per day (8 hr) (about 25 nos. of 20 cm diam vessels) is estimated at Rs 1.69 lakhs. The cost of plating 1 m^2 of surface comes to Rs 750.

Further particulars may be obtained from : The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

CSIR SUPPORT TO RESEARCH

New Schemes

Inorganic Ion-exchangers based on Lead and Thorium

The study of synthetic inorganic ion-exchangers has attracted considerable attention in recent years in view of their superiority over organic resins under conditions of high temperatures or presence of ionizing radiation. The study is of considerable importance not only from the point of view of analytical applications but from the view point of structural chemistry since it throws light on such phenomena as sorption of ions by precipitate, electrophoretic behaviour of suspensions, diffusion of ions in crystals, and isotopic exchange in heterogeneous systems. Inorganic ion-exchangers containing some metals of group IV (tin, titanium and tungsten) and a few salts of zirconium and cerium have been synthesized and their analytical applications studied. Under a new CSIR research scheme, Dr A. K. De (principal investigator) of the Department of Chemistry, Visva Bharati, Santiniketan (W. Bengal) proposes to synthesize some inorganic ion-exchangers of lead and thorium as also some ammonium salts, and study their properties, structural aspects and analytical applications.

Inorganic Ion-exchange Materials

Inorganic ion-exchangers are stable to heat and radiations and hence are of considerable use in the purification of water and treatment of radioactive wastes. These ion-exchangers are very specific in their behaviour; for instance, titanium tungstate is specific for Ca^{2+}, Mg^{2+} and Sr^{2+}, and stannic molybdate and tungstate are specific for Pb^{2+}. Under a new CSIR research scheme granted to him, Prof. Mohsin Qureshi of the Z. H. College of Engineering and Technology, Aligarh Muslim University, Aligarh, proposes to synthesize new inorganic ion-exchangers; and to study their ion exchange properties, structure and analytical applications.

Enzymes and Regulation of Testicular Functions

Relatively little is known about the enzyme activities and their biological functions in the mammalian testes and more particularly during the process of spermatogenesis. Dr R. S. Mathur of the Department of Zoology, Rajasthan University, Jaipur, who worked on this problem, has observed that both 5-nucleotidase and ATPase which show minimal activity in the initial phases of spermatogenetic process become active in the latter period to accelerate the spermatid differentiation into the final spermatozoa. The esterase activity seems to be associated with phagocytosis which is evidenced by the increased lysosomal activity in the degenerating testicular cells. Under a new CSIR research scheme granted to him, Dr Mathur proposes to extend these studies to other enzymes and to evaluate the data not only histochemically but also quantitatively. Investigations will be made using the common house shrew *Suncus murinus sindensis* Anderson. The investigations are aimed at the understanding of the basic biological function of the enzymes in the testes and their role in the process of spermatozoa differentiation. This will be a purely biochemical parameter which if correlated with the hormonal activity will be of immense significance in the field of reproductive biology.

Binding of Inorganic Ions to Protein

Biological activities and chain conformations of proteins and enzymes are known to be affected by the presence of salts. Certain ions show specificity in binding at different sites in proteins. The specific solvation of modified albumin by lithium salts and the specific action of calcium ion in biological processes have been reported. In a new CSIR research scheme sanctioned at the Department of Chemistry, Indian Institute of Technology, Kanpur, Dr D. Balasubramanian (principal investigator) proposes to make a study of the nature and extent of binding of the salts of group I and II metals of the periodic table to certain selected proteins (globular enzymes like lysozyme and ribonuclease) and also the conformational and activity consequences of such binding.

Chemistry of Plant Products Exhibiting Antifungal Properties

In recent years the antifungal properties of coumestane derivatives have aroused considerable interest. Some new pterocarpinoid and coumestane derivatives have been isolated from *Flemingia chappar* (Leguminosae) by Dr N. A. Choudhury, Faculty of Agriculture, Kalyani University, Kalyani. Under a new CSIR research scheme sanctioned to him, Dr Chaudhury proposes to investigate the chemistry of pterocarpinoids and coumestane derivatives occurring in the various species of the genus *Flemingia* and to search for other related oxygen heterocycles. The study is expected to throw light on the structure-activity relationship of the coumestanes and pterocarpinoid derivatives showing antifungal properties.

Completed Schemes

Mechanism of Ferricyanimetric Oxidations

Ferricyanimetry has attracted the attention of analytical chemists due to its oxidative capacity in alkaline medium, facilitating direct and indirect estimation of many substances. The literature on the mechanism of such oxidation processes is, however, scanty. With a view to understanding the mechanism of ferricyanimetric oxidations, studies were made by Dr M. C. Agrawal at the Department of Chemistry, University of Allahabad, Allahabad, under a CSIR fellowship during October 1968 to November 1971. Kinetics of oxidation of ascorbic acid, arsenite, hydrazine, hydroxylamine, selenium(IV) and tellurium(IV) were studied employing ferricyanide in acid as well as alkaline media.

Oxidation of ascorbic acid at *p*H 1·1 showed first order dependence on the concentrations of both ascorbic acid and ferricyanide, and an inverse first order dependence on hydrogen ion concentration.

The end product was dehydroascorbic acid. The mechanism and the steps involved have been worked out.

Oxidation of arsenite at *p*H 12 revealed that a pre-equilibrium exists between the various arsenite species [As $(OH)_3$, $AsO(OH)_2^-$, $AsO_2(OH)^{2-}$, AsO_3^{3-}] and hydroxide ions. Oxidation of hydrazine by alkaline ferricyanide (*p*H 9·9-11·4) was studied in the presence of 50% methanol. The reaction was independent of the hydroxide ion concentration. This has been supported by the fact that above *p*H 10, hydrazine exists as the neutral molecule (N_2H_4) and therefore the rate-determining step involves the direct interaction between N_2H_4 and Fe $(CN)_6^{3-}$.

Oxidation of hydroxylamine (*p*H 4·2-5·7), using acetate buffer, showed that the stoichiometry of the reaction was variable, being 1:1 for high concentrations of hydroxylamine. The order of the reaction was unity with respect to ferricyanide, hydroxylamine and the reciprocal of hydrogen ion concentration. The results showed negligible salt effect, and a positive dielectric effect. The energy and entropy of activation were found to be 11·8 kcal/mol and –25·6 cal deg^{-1} mol^{-1}.

Oxidation of selenium(IV) showed first order dependence on all the four reacting species, viz. Se(IV), Os(VIII), $Fe(CN)_6^{3-}$ and OH^-, and an inverse first order dependence on $Fe(CN)_6^{4-}$. The energy of activation was found to be 2·49 kcal/mol and the specific rate constant at 35°, $14{\cdot}3 \times 10^{-6}$ l^3 mol^{-3} sec^{-1} at 35°.

The kinetic data of osmium(VIII)-catalyzed oxidation of tellurium (IV) by ferricyanide were found to be different from those obtained in the case of selenium(IV). The rate of oxidation was independent of Te(IV) concentration, and ferrocyanide had no effect on the reaction rate. A mechanism involving the interaction of the alkaline species of Os(VIII) with ferricyanide to form a complex in the rate-determining step, was proposed; this satisfactorily accounts for the observed kinetics.

Adsorption Studies on Iron Fischer-Tropsch Catalysts

Studies on Fischer-Tropsch synthesis employing iron catalysts for the hydrogenation of carbon monoxide were made by Dr K. Subramanyam, a CSIR research fellow, at the Department of Inorganic & Physical Chemistry, Indian Institute of Science, Bangalore during September 1969 and October 1971. Surface areas, free metallic areas active in chemisorption and adsorption of hydrogen and carbon monoxide at elevated temperatures were studied for two catalysts, one of which was prepared from ferric nitrate solution and the other from ferric chloride solution, S(I) and S(II) respectively, in reduced and carbided forms.

The catalysts were prepared by the precipitation method and surface areas were measured by BET method using nitrogen as adsorbate at −184°C and the free metallic area was calculated using the Anderson's method.

In general, it was found that the surface area decreased with increasing temperature of pretreatment. The surface area of the carbides was nearly the same (about 40 m^2/g) when the catalyst was prepared by treatment with carbon monoxide or a 1:1 mixture of hydrogen and carbon monoxide.

The specific surface areas for the reduced catalysts S(I) and S(II) were found to be 48·7 m^2/g and 34·2 m^2/g showing that the catalyst obtained by the chloride method has less surface than that obtained by the nitrate method. the difference being about 30%. Similarly, the calculated free metal areas active in chemisorption are 39·6% and 32% of the total area for S(I) and S(II) respectively, showing that S(II) has 20% less area than S(I). When the catalysts are carbided, the total surface area decreases in proportion to the areas for reduced samples. However, a comparison of the free metal areas reveals that carbided S(I) has more than thrice the area of S(II) [11·2% for S(I) and 3·03% for S(II)].

During the synthesis, the iron catalysts are converted to the carbides whose subsequent performance determines the course of the synthesis. Chemisorption of carbon monoxide is the most important step in the synthesis at elevated temperatures (180-220°C), and therefore the catalyst that has greater surface for chemisorption on carbiding is preferred for the synthesis. Thus, S(I) gives better performance than S(II).

Studies on the adsorption of hydrogen and carbon monoxide from single gases have revealed that carbided sample S(I) adsorbs about 75% more carbon monoxide than the reduced catalysts at 50°C. In the case of S(II), both the reduced and carbided samples adsorb very small amounts of carbon monoxide. Carbided S(II) adsorbs less than 50% of the amount of hydrogen adsorbed by S(I). This observation, combined with the observation that S(II) has low adsorptive capacity for carbon monoxide at 50°C, leads to the conclusion that S(I) is better than S(II). Further, carbided catalysts in general have better adsorptive properties than reduced catalysts and hence show higher catalytic efficiency in synthesis.

PATENTS ACCEPTED

Indian Pat. 130551

A new process for separation of the dimethyl and monomethyl components from a mixture of dimethyldichlorosilane and methyltrichlorosilane

J. Gupta, C. Gopinathan, (Mrs) S. Gopinathan, M. J. Eapen & P. A. Awasarkar
NCL, Poona

Dimethyldichlorosilane is a major intermediate required in the manufacture of silicones, an industry which is rapidly expanding in the country. The chemical is presently imported. It is first hydrolyzed to the siloxane oligomers, which on polymerization yield most of the silicone polymers, and various silicone compositions.

In the synthesis of dimethyldichlorosilane (I) from methyl chloride and silicon, methyltrichlorosilane (II) is also formed. Both I and II are highly volatile, moisture-sensitive corrosive liquids and have very similar physical and chemical characteristics. As their boiling points differ by less than 4° (70.2° and 66.8° respectively) fractionating columns equivalent to hundreds of theoretical plates are required for an efficient separation. A relatively simple process for the separation of the dimethyl and monomethyl components from a mixture of I and II in a high degree of purity has been developed by NCL, Poona.

When a mixture of I and II is esterified with an alcohol (such as methanol or ethanol), methyl siliconic esters (and chloro esters) are formed. To obtain good yields without using a hydrogen chloride acceptor esterification must be carried out under such controlled conditions that no water accumulates in the system as a result of a side reaction between alcohol and hydrogen chloride. The boiling points of the esters differ more widely than the boiling points of the parent methyl chlorosilanes; and hence it is easier to separate the esters by fractional distillation. The dimethyl component (obtained as a mixture of diester and chloroester) is hydrolyzed by adding a small amount of cold water when the dimethyl siloxane oligomers separate nicely as an oily layer. This oil has been found to be quite suitable, in laboratory experiments, for polymerization. The monomethyl component, on the other hand, is obtained in the latter part of the distillation as the pure triester which is quite stable, non-corrosive, and is a good substitute for most of the purposes for which methyltrichlorosilane is presently used.

The recovery of dimethyl and monomethyl compounds from a mixture of the two chlorosilanes by the use of methanol in preference to higher alcohols is dealt with in the patent. Consistently high yields (about 95%) of the dimethyl component have been obtained from chlorosilane mixtures containing more than 50% (by wt) of dimethyldichlorosilane.

The process is likely to find application in the fractionation of Rochow liquid mixture, the major components of which are dimethyldichloro- and monomethyltrichlorosilanes.

Indian Pat. 126121

Process for the production of water-soluble varnishes for coatings from cardanol

T. Ramalingam, B. G. K. Murthy & M. A. Sivasamban
RRL, Hyderabad

Cashewnut shell liquid (CNSL) is an important plant phenolic material which has found a number of industrial applications. CNSL and its major constituent, cardanol, which is obtained by the distillation of CNSL under suitable conditions, are extensively used in paint industry. However, cardanol is a new entrant in the field of water-soluble coatings in which water is used as thinner in place of costly organic solvents, thus eliminating the hazards of inflammability. These compositions are also highly suitable for the electrodeposition of paints on metal surface, a technique which is becoming popular in the automobile industry.

The process covered by the patent relates to the production of water-soluble varnishes and paints from cardanol. Cardanol is maleinized with maleic anhydride at 150-200°C with or without catalyst till a maximum amount of maleic anhydride adduct has been formed. This adduct is neutralized either directly with ammonia or with water-soluble amines, followed by blending with water-soluble hydroxy materials like phenol methylols in amounts equivalent to the carboxyl content of the product. The material is then thinned with water to 40-60% non-volatiles, and water-soluble driers (cobalt acetate and manganese acetate) are added. These varnishes when applied as thin films on mild steel substrates and baked at temperatures ranging from 120° to 160°C for 1 to 2 hr yield golden yellow glossy films which possess satisfactory flexibility, hardness and resistance to water, alkali and acid solutions and common organic solvents. Satisfactory paints are also prepared by grinding suitable pigments with the varnish.

Indian Journal of Radio and Space Physics

The first issue of the *Indian Journal of Radio and Space Physics*, a quarterly being published by the Publications & Information Directorate of the Council of Scientific & Industrial Research in association with the Indian National Science Academy, New Delhi, has just been released. This 118-page issue (March 1972) contains 15 papers covering the various areas of radio and space physics. This quarterly periodical is devoted to research communications (full papers and short communications) in the following areas of radio and space physics: Radio frequency standards and measurements; propagation through non-ionized media; Ionospheric propagation; Magnetosphere; Radio and radar astronomy; Physics and chemistry of ionosphere; Neutral atmosphere; Airglow; Winds and motion in the upper atmosphere; Stratosphere-mesosphere coupling; Ionosphere-magnetosphere coupling; and Solar-terrestrial relationship.

PINUS

This is the seventh in the series of botanical monographs published by the Publications & Information Directorate, New Delhi.

Being a source of timber, resin, turpentine, and paper pulp, *Pinus* is very important amongst the conifers represented in India. Of the six species of *Pinus* occurring in India, four species, viz. *P. roxburghii*, *P. wallichiana*, *P. insularis*, and *P. gerardiana*, are distributed in the Himalayas.

Compiled by (late) Prof. P. Maheshwari and Dr R. N. Konar of the Department of Botany, University of Delhi, Delhi, the monograph deals with the morphology, anatomy, embryology and cytology of the Himalayan pines—the Chir (*P. roxburghii* and the Kail (*P. wallichiana*). Important fungal and insect diseases have also been dealt with, and a chapter has been added on Angiospermic Parasites.

The publication (royal 8vo, 130 pages) contains 60 illustrations, a bibliography and an index, and would be useful to teachers, research workers and students of botany and forestry.

PATENTS SEALED

123642: A process for the production of matrix board (stereo flong), C. N. Saikia, N. C. Nandi, B P. Chaliha, S. B. Lodh & M. S. Iyengar—RRL, Jorhat.

123838: Improvements in or relating to hard ferrites, T. V. Ramamurti, S. C. Gupta, N. R. Nair & B. S. Khurana—NPL, New Delhi.

123998: An improved process for the preparation of substituted alkyl nitrate esters from glycol ethers, P. Desikan & K. K. Bhattacharyya—IIP, Dehra Dun.

123999: An improved process for the preparation of alkyl nitrate esters from alicyclic alcohols, P. Desikan & K. K. Bhattacharyya—IIP, Dehra Dun.

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17 JUN 1972

Shanti Swarup Bhatnagar Memorial Awards: 1965-1969

Twenty-three distinguished Indian scientists received Shanti Swarup Bhatnagar Memorial Awards—the nation's highest award for contribution to science in our country—from Shri C. Subramaniam, Minister for Planning, Science and Technology, and Vice-President, CSIR, at a function held at Vigyan Bhawan, New Delhi on 27 April 1972. The awards are for the years 1965 to 1969 in Physical, Chemical, Biological, Medical, Mathematical and Engineering Sciences. Besides, one award was made posthumously to late Dr J. B. Chatterjee and two awards were given in absentia.

The awards were instituted in memory of the late Dr S. S. Bhatnagar by the Council of Scientific & Industrial Research in 1957 with a view to providing incentive to research workers in the country, and are given annually to Indian scientists for outstanding contribution in any field of scientific research during the preceding 5 years. With effect from 1960, five prizes each of Rs 10 000 are being awarded annually in Physical, Chemical, Biological, Medical, and Engineering Sciences. A sixth prize in Mathematical Science is awarded in alternate years.

Shri C. Subramaniam, who gave away the awards, said in his address that the country has already achieved a measure of success in utilizing science and technology for achieving some major goals of the country's development policies. What we are seeking today now, the Minister continued, is to extend and expand this process so that the forces of modern science may be brought to bear upon the problems faced by the common man for satisfying his essential needs. In this stupendous task, scientists and technologists have a crucial role to play, the Minister added.

Dr Y. Nayudamma, Director General, Scientific & Industrial Research, said in his welcome address that scientists must concern themselves with the basic needs of the people, such as food, clothing and sanitation, and therefore it is opportune for us to prove equal to this task. Continuing, the Director General said that India has been intrinsically strong in the store of natural resources and building up of a big reserve of qualified scientists and engineers. Both these factors can be applied in our favour for achieving the social tasks set before us. He called upon the scientists and technologists to make a resolve that they shall be the propellants and catalysts for bringing about such a social progress intertwined with economic and industrial growth.

Shri K. G. Krishnamurthi, Secretary, CSIR, read out the citations which are reproduced below:

CITATIONS

Prof. C. V. Subramanian

The Shanti Swarup Bhatnagar Memorial Award for the year 1965 has been made to Prof. C. V. Subramanian for his outstanding contributions in the field of Hyphomycetology.

Prof. Subramanian has successively held the positions of Professor of Plant Pathology, Indian Agricultural Research Institute, New Delhi, and Head of the Department of Botany, University of Rajasthan, and is now Professor of Botany, University of Madras. He has established an active school of research in taxonomy and biology of fungi. His most significant contributions are on taxonomy of Fungi imperfecti. His systematic exploration of the hyphomycete flora of India led to the discovery of many new and interesting genera. He has proposed a new system of classification of Hyphomycetes based on conidium ontogeny. His studies and original interpretations of conidium ontogeny based on cell-wall relationships have led to the formulation of a terminology built on new concepts. Prof. Subramanian is also well known for his work on soil mycology and soil-borne plant diseases, and for his contributions to our knowledge of the systematics, distribution and ecological behaviour of soil Fusaria, and of the nutritional physiology, mainly nitrogen utilization, of plant pathogenic species of *Fusarium* and *Drechslera*.

Prof. Subramanian has published about 100 original scientific papers and a monograph on Hyphomycetes. He is a Fellow of the Indian National Science Academy, and of the Indian Academy of Sciences.

Dr K. G. Ramanathan

The Shanti Swarup Bhatnagar Memorial Award for the year 1965 has been made to Dr K. G. Ramanathan for his outstanding contributions in the field of Mathematics.

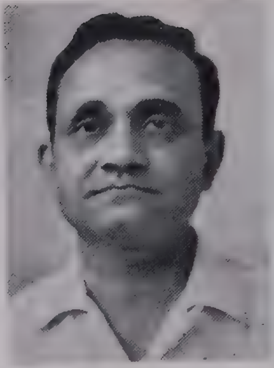
Dr Ramanathan has been Dean of the Mathematics Faculty at the Tata Institute of Fundamental Research, Bombay. He worked with Prof. Carl Siegel at the Institute for Advanced Study at Princeton (USA). His work concerns mainly three aspects of Number Theory: Study of arithmetical groups, Diophantine inequalities, and Automorphic functions related to quadratic forms. The work on arithmetical groups relates to the solution of some important problems concerning their finite generation, commensurability and maximality. The work on Diophantine inequalities is related

RECIPIENTS OF BHATNAGAR MEMORIAL AWARDS 1965-1967

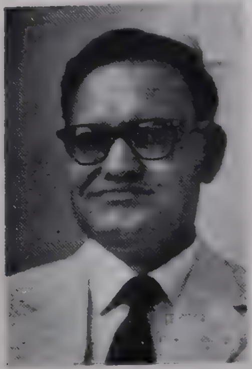
Prof. C. V. Subramanian

Dr K. G. Ramanathan

Dr S. Ramaseshan


Dr S. C. Jain

Dr N. A. Ramaiah


Dr H. K. Jain

Dr N. Ganga Prasada Rao

Dr Jai Krishna

Prof. D. Lal

Prof. M. Santappa

Prof. A. K. Sharma

to problems of Davenport on the density of values of quadratic and other arithmetical forms. His recent work on automorphic functions is related to the Siegel formula and is a notable contribution to analytic number theory.

The School of Mathematics of the Tata Institute of Fundamental Research started its graduate programme after Dr Ramanathan joined it. The Institute has now one of the finest groups of number theorists whose contribution to various aspects of number theory is known throughout the world. He is a Fellow of the Indian National Science Academy, and Editor, Journal of the Indian Mathematical Society, a journal of standing in the mathematical world.

Dr S. Ramaseshan

The Shanti Swarup Bhatnagar Memorial Award for the year 1966 has been made to Dr S. Ramaseshan, jointly with Dr S. C. Jain, Director, Solid State Physics Laboratory, for his outstanding contributions in the field of Physical Sciences.

Dr Ramaseshan is at present Head of the Materials Science Centre of the National Aeronautical Laboratory, Bangalore. He had his early training in optics and crystallography under Prof. C. V. Raman. He co-authored a definitive article on 'Crystal Optics' in Flugges' *Handbuch der Physik* with Prof. G. N. Ramachandran, another Bhatnagar Memorial Award winner. He has published many significant articles on piezo-optic phenomena and an analyzer for polarized light goes after his name.

Dr Ramaseshan is a recognized authority in the field of X-ray crystallography. He has established a school in this subject in India. He was also associated with the development of instrumentation for high and low temperature X-ray crystallography.

Dr Ramaseshan's most outstanding work relates to the field of anomalous scattering X-rays and neutrons and their application to the understanding of the structure of matter. This technique has been employed for elucidating the structures of many large molecules, including insulin. Recently it has been extended to the study of the strengthening mechanisms in solids and to the study of the liquid and amorphous states.

In recent years, Dr Ramaseshan has been involved in the application of science to technology. He has made contributions to the field of composites and to unconventional fabrication processing of materials. He is a Fellow of the Indian Academy of Sciences.

Dr S. C. Jain

The Shanti Swarup Bhatnagar Memorial Award in Physical Sciences for the year 1966 has been made to Dr S. C. Jain, jointly with Dr S. Ramaseshan, Scientist, National Aeronautical Laboratory, Bangalore.

Dr Jain is at present Director of the Solid State Physics Laboratory of the Defence Research and Development Organization. He had his early training in physics while working for more than a decade with the late Dr K. S. Krishnan at the National Physical Laboratory, New Delhi.

Dr Jain has published several papers in the fields of defects and colour centres in polar crystals; high temperature properties of solids; Raman, infrared and electronic spectra of crystals; thin films; and ultra-purification of semi-conductors and semi-conductor devices. Some of the techniques developed by Dr Jain in experimental physics have been used in many laboratories in the United States and in western European countries. His work has been acclaimed as outstanding and has been quoted extensively in textbooks, treatises and research papers. In recent years, Dr Jain has been much involved in the design and development of sophisticated electronic items to meet the requirements of Armed Forces.

Dr Jain is a member of several learned societies and is on the editorial boards of the Journal of Material Science, Crystal Lattice Defects, Radiation Effects, and

Prof. T. R. Anantharaman

Dr M. J. Thirumalachar

Dr A. K. Basu

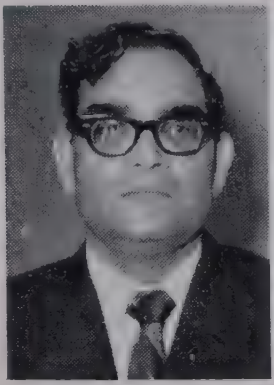
Dr A. P. Mitra

Prof. C. N. R. Rao

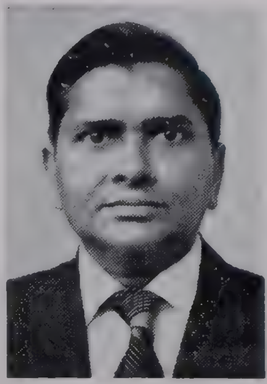
Dr T. A. V. Subramanian

Dr K. R. Chakravorty

Dr S. R. Mukherjee


Dr U. K. Sheth

Dr A. N. Mitra


Prof. A. C. Jain

Prof. S. Kalyanaraman

Journal of Non-Metals. He is the editor of two books: (i) Non-Metallic Crystals; and (ii) Recent Advances in Theory and Technology of Semi-conductors.

Dr N. A. Ramaiah

The Shanti Swarup Bhatnagar Memorial Award for the year 1966 has been made to Dr N. A. Ramaiah for his outstanding contributions in the field of Sugar Chemistry and Technology.

Dr Ramaiah is at present Deputy Secretary, Sugar Industry Enquiry Commission, New Delhi. Earlier he was Professor of Physical Chemistry at the National Sugar Institute, Kanpur. After a bright academic career in the Banaras Hindu University, he did teaching and research work at the Banaras Hindu University as well as at the Delhi University and his research work in the area of physical chemistry was considerable and of a high order. Later he joined the National Sugar Institute and vigorously applied his keen mind and his scientific knowledge for the solution of problems concerned with sugar manufacture. He carried out his work not only in the laboratory but also extended it to its development in the industry. His most important studies relate to : (i) colour problems of the sugar industry and physical methods for assessment of colour; and (ii) the manufacture of active carbon and chemicals for the improvement of sugar house products. As a result, sugar manufacture has been made more economical and there has been saving in sulphur, which is a scarce material in this country. The importance of his work has been recognized by the sugar industry through the award of medals and prizes. He is a Fellow of the Indian National Science Academy.

Dr H. K. Jain

The Shanti Swarup Bhatnagar Memorial Award for the year 1966 has been made to Dr H. K. Jain, jointly with Dr N. Ganga Prasada Rao, for his outstanding contributions in the field of Biological Sciences.

Dr Jain is at present Head of the Division of Genetics at the Indian Agricultural Research Institute, New Delhi. He has made extensive contributions in the field of genetic recombination, including its mechanism and regulation, more particularly its control at the interchromosome level. A new hypothesis on such a control has been developed and considerable experimental evidence has been obtained in support of it. Dr Jain's work on tomato and more recently on *Drosophila* has provided what is regarded as the first convincing evidence in support of the phenomenon of mutagen specificity. The manipulation of mutation rates and spectrum has been one of the most important objectives of contemporary mutation research, and Dr Jain's work has been an important contribution in this direction. His other studies relate to the synthesis of RNA in plant cells, more particularly the demonstration of the hyperactive nature of the nucleolus-organizing locus in this synthesis.

Dr Jain has been President of the Indian Society of Genetics and Plant Breeding and has attended a number of international scientific meetings, including the Twelfth International Congress of Genetics held at Tokyo in 1968. Dr Jain has developed an active school of research in the field of mutagenesis and cytogenetics at the Indian Agricultural Research Institute.

Dr N. Ganga Prasada Rao

The Shanti Swarup Bhatnagar Memorial Award for the year 1966 has been made to Dr N. Ganga Prasada Rao, jointly with Dr H. K. Jain, for his contributions in the field of Biological Sciences.

Dr Ganga Prasada Rao is at present Project Coordinator (Sorghum) and Head, Regional Research Station, IARI, Hyderabad. Dr Rao's primary contribution is in the field of sorghum breeding, relating to the release of the first commercial sorghum hybrids CSH-1 and CSH-2 in India. Subsequently, a high yielding variety, *Swarna*, that equalled the commercial hybrid CSH-1 in yield levels was also developed and released for general cultivation. The performance of the first hybrids, following their release, amply demonstrated that the average yields of this rain-fed crop could be stabilized at 2000-2500 kg/ha as against the national average of only 400-500 kg/ha. Maximum yields of the order of 7000 kg/ha were recorded under optimum conditions. These hybrids also performed well in several African, South East Asian and Latin American countries. The advent of the hybrids has given rise to an organized hybrid sorghum seed industry in the public as well as private sectors.

Dr Rao's contributions to basic biological sciences include the discovery of apomixis, the production of seed without the union of male and female gametes, which has potentialities in developing perpetual hybrids. The present efforts of Dr Rao and his associates are aimed at combining the individual superiority of Indian varieties with the community performance of exotics through exotic-Indian crosses.

Dr Rao was awarded the C. Subramanian gold medal, B.V.L. Narayana's gold medal and a medal by the Indian Society of Genetics and Plant Breeding. Dr Rao has over 50 research publications to his credit.

Dr Jai Krishna

The Shanti Swarup Bhatnagar Memorial Award for the year 1966 has been made to Dr Jai Krishna for his outstanding contributions in the field of Engineering Sciences.

Dr Jai Krishna is at present Vice-Chancellor, Roorkee University and also Professor and Director, School of Research and Training in Earthquake Engineering, Roorkee. Dr Jai Krishna has made valuable contributions in the field of earthquake engineering. His work has brought in new and original ideas in the design and construction of earthquake-resistant structures and has resulted in the evolution of economic design and construction practices. Some of his noteworthy contributions in this field are : (1) Evolving methods of strengthening brick buildings to resist earthquake forces ; (2) design, construction and installation of structural response recorders and accelerographs in India to collect seismic data for the design of structures ; (3) earthquake-resistant design of water towers and other structures of post-earthquake importance ; (4) earthquake-resistant design of dams, bridges and other major structures ; and (5) introducing the concept of isoacceleration lines indicative of the earthquake forces in the epicentral tracts for the study of the distribution and attenuation of energy from the earthquake source. He has published more than sixty papers and a textbook on reinforced concrete in two volumes.

Dr Jai Krishna was awarded a gold medal and a cash prize by the Institution of Engineers (India) in 1960 and Khosla Research Award by the Roorkee University in 1963. He is a Fellow of the Indian National Science Academy, American Society of Civil Engineers and the Institution of Engineers (India). He is the Founder President of the Indian Society of Earthquake Technology and a member of UNESCO Consultative Committee on Earthquake Engineering.

Dr J. B. Chatterjea*

The Shanti Swarup Bhatnagar Memorial Award in Medical Sciences for the year 1966 has been given to Dr J. B. Chatterjea for his outstanding contributions in the fields of nutritional anaemias and hemoglobinopathies.

Dr Chatterjea, who was Director, Calcutta School of Tropical Medicine, Calcutta, was able to elucidate the aetiopathogenetic aspect of the common disorders of human red cells that had unfolded the spectrum of hereditary disorders of human haemoglobin as prevailing in India. His discovery of haemoglobin-E in Bengalis and the comprehensive studies of haemoglobin-E thalassaemia disease from clinical, haematological, biochemical, biophysical and genetical aspects have provided excitingly new information and greatly enriched the relevant areas of contemporary medical sciences.

Dr Chatterjea was the author of a large number of original research papers and had contributed valuable chapters in many international textbooks and monographs. He had also received a number of medals and prizes in India for his outstanding contributions in medicine. He was Fellow of several learned societies both in India and abroad.

Dr R. J. Vakil

The Shanti Swarup Bhatnagar Memorial Award in Medical Sciences for the year 1966 has been made to Dr R. J. Vakil for his outstanding contributions in the field of Cardiology.

Dr Vakil has to his credit a number of awards and medals from various universities, including Albert Lasker Award in Medical Research of the American Health Association, and B. C. Roy National Award given by the Indian Medical Council. Dr Vakil's contribution to the discovery of the use of *Rauvolfia serpentina* is well known and widely recognized.

Dr Vakil has been in the forefront of clinical cardiology in this country for well over two decades. He is the author of a large number of original research papers and books in the field of cardiology. Dr Vakil is a Fellow of several learned societies both in India and abroad.

Prof. D. Lal

The Shanti Swarup Bhatnagar Memorial Award in Physical Sciences for the year 1967 has been given to Prof. Devendra Lal for developing new techniques for studying radioisotopes and for his outstanding contributions to the subject of geophysics.

Prof. Lal is at present Professor in the Geophysics Research Group, Tata Institute of Fundamental Research, Bombay. His special interest in recent years has been the study of isotopic changes induced by cosmic rays on the earth and extraterrestrial objects. He has extensively developed this broad area, which encompasses several fields in earth sciences and astrophysics. By the use of sensitive low-level radiation counting techniques, radioisotopes produced by cosmic radiation in the earth's atmosphere were detected and used as tracers for studies in the fields of meteorology, hydrology and oceanography. He is responsible for setting up two laboratories at the Tata Institute of Fundamental Research as national facilities—one for archaeological studies, based on cosmic ray produced radiocarbon, and the other for hydrological studies using natural and artificial tritium activity. He has shown that the results of studies of cosmic ray produced radioactivities in meteorites are indicative of the fact that the cosmic ray intensity during the last few million years has been the same as it is today.

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*since deceased.

Prof. Lal was elected Fellow of the Indian Academy of Sciences in 1965, was awarded the Krishnan Gold Medal for Geochemistry-Geophysics in 1965, and the unrestricted ' American Chemical Society-Petroleum Research Fund, Grant C for Established Scientists ' in 1967. He is a member of several scientific committees and organizations in India and abroad, and is on the editorial board of the Journal of Earth and Planetary Science Letters.

In recognition of his outstanding scientific researches, Prof. Lal was awarded Padma Shri in 1971.

Prof. M. Santappa

The Shanti Swarup Bhatnagar Memorial Award for the year 1967 has been made to Prof. M. Santappa for his outstanding contributions in the field of Polymer Chemistry.

Prof. Santappa is a distinguished graduate from the Universities of Madras, Manchester and London and he is at present Senior Professor and Head of the Department of Physical Chemistry at the University of Madras.

Prof. Santappa's achievements relate to the synthesis of graft copolymers by a simple chain transfer process and studies on the properties of macromolecules by light scattering and osmotic techniques. Syntheses and kinetic studies of condensation polymers involving tetra- and tri-alkyl phenols and formaldehyde have yielded valuable information. Complementary to the polymerization studies, oxidation of various organic substrates has also been investigated.

Prof. Santappa has built up a flourishing school of research and has trained a large number of students in polymer chemistry, oxidation kinetics and complexometry. He has to his credit a large number of publications in internationally reputed journals. He is a Fellow of the Indian National Science Academy.

Prof. A. K. Sharma

The Shanti Swarup Bhatnagar Memorial Award for the year 1967 has been made to Prof. Arun Kumar Sharma for his outstanding contributions in the field of Cytogenetics.

Prof. Sharma is University Professor and Head of the Department of Botany at the University of Calcutta. He has built up an active school of research since 1948 on cytogenetics and cytochemistry. The principal contributions made by him and his colleagues include the development of a number of new techniques for the study of detailed chromosome structure of plants. A new concept of speciation in plants reproducing through sexual means has been developed and established by his group. He has also been able to induce division in adult nuclei through the application of chemicals and this has importance in cell rejuvenescence.

Prof. Sharma is a Fellow of the Indian National Science Academy and Chief Editor (jointly with Dr A. Sharma) of Nucleus, an international journal of cytology. He is a member of the editorial boards of several foreign and Indian journals, including Cytologia (Japan), Proceedings of the Indian National Science Academy (B), Science and Culture, and Journal of Cytology and Genetics. He has attended a number of international conferences in the fields of cytology, genetics, cytochemistry and botany.

Prof. Sharma has nearly 300 research papers to his credit, published in different foreign and Indian journals.

Prof. T. R. Anantharaman

The Shanti Swarup Bhatnagar Memorial Award for the year 1967 has been made to Prof. T. R. Anantharaman for his outstanding contributions in the field of Engineering Sciences.

Prof. Anantharaman is at present Head, Department of Metallurgical Engineering and Dean, Faculty of Engineering and Technology, Banaras Hindu University, Varanasi. He is among the first few metallurgical engineers in the country to have truly upheld the dual responsibility of teaching as well as research at an academic institution. The greatest impact of his many significant contributions covered in over 100 research publications is to be found in the fervour for research he has generated among his collaborators, colleagues and students. He has made important contributions to the theory of plastic deformation, to the understanding of precipitation stages in supersaturated solid solutions, and to the use of refined low-angle X-ray scattering techniques.

Prof. Anantharaman is a Fellow of the Institution of Metallurgists, London, the Indian Academy of Sciences, and the Indian National Science Academy. He is a member of the Indian Institute of Metals, American Society for Metals, American Institute of Mining, Metallurgical & Petroleum Engineers, American Foundrymen's Society, Iron & Steel Institute, London and Deutsche Gesselschaft fur Metallkunde, Germany.

Prof. Anantharaman is a Rhodes Scholar and a Kamani Gold Medallist. In 1964, he was nominated 'Metallurgist of the Year' by the Ministry of Steel and Mines, Government of India.

Dr M. J. Thirumalachar

The Shanti Swarup Bhatnagar Memorial Award in Medical Sciences for the year 1967 has been given to Dr M. J. Thirumalachar for his outstanding contributions in the field of Mycology and Plant Pathology.

Dr Thirumalachar, Superintendent, Hindustan Antibiotics Research Centre, Pimpri, Poona, has to his credit considerable work in the fields of medical mycology and plant disease control.

Studies carried out under the guidance of Dr Thirumalachar have led to the discovery of a new antiparasitic antibiotic, antiamoebin, which is being used by the Armed Forces for deworming military dogs. When fed with animal feed, it increases the yield of milk in cows, and enhances egg production in poultry. In the field of antibiotics he has been able to develop the antifungal antibiotics Hamycin, Dermostatin, Aureofungin, MYc-4 and Tetraenenin.

Dr Thirumalachar has published 390 research papers in the fields of mycology, plant pathology, morphology of higher plants, biological control using microorganisms and antibiotics. He is a recipient of the Sunder Lal Hora Medal of the Indian National Science Academy.

Dr A. K. Basu

The Shanti Swarup Bhatnagar Memorial Award in Medical Sciences for the year 1967 has been made to Dr A. K. Basu for his outstanding contributions in the field of Surgery.

Dr Basu, Emeritus Professor, Department of Surgery, Institute of Post-Graduate Medical Education and Research, Calcutta, has made significant contributions to the problem of liver disease through a multi-disciplinary approach. His work on non-cirrhotic portal hypertension is well known and is a distinct contribution. He has also played a notable part in the development of surgical science in this country. He has made equally significant contributions in raising the standard of post-graduate education on surgery.

Dr Basu has been the Vishevnsky Medallist of the Institute of Surgical Research, USSR, and an Honorary Member of the Association of Surgeons of Great Britain and Ireland.

Dr Basu is the author of a large number of original research papers. He is a fellow of several learned societies both in India and abroad.

Dr A. P. Mitra

The Shant Swarup Bhatnagar Memorial Award for the year 1968 has been made to Dr A. P. Mitra for his outstanding contributions in the field of Earth's Near Space Environment and especially in the areas of Ionospheric Physics and Chemistry.

Dr Mitra is at present Scientist, National Physical Laboratory, New Delhi. He is one of the acknowledged authorities on ionosphere and on some aspects of space research. His pioneering work on the use of cosmic radio noise for studies of the upper atmosphere resulted in a whole series of scientific discoveries in ionosphere, solar physics and cosmic rays. He has carried out comprehensive studies on the ionospheric effects of solar flares and has established one of the most extensive radio flare systems at the National Physical Laboratory. He developed an atmospheric model from observations of satellite drag and initiated new D-region rocket experiments. Dr Mitra's work on ion and neutral chemistry in the upper atmosphere, and especially on the minor constituent nitric oxide, provided the basis for much of our present knowledge of the lower ionosphere. He has contributed substantially to the establishment and operation of the International Spacewarn System and the International Ursigramme and World Day Service.

Dr Mitra was elected Fellow, Indian National Science Academy in 1961, and was elected Corresponding Member, International Academy of Astronautics in 1963 for distinguished contribution to space science. He is also connected with several national and international bodies including COSPAR. He is on the editorial boards of leading national and foreign professional publications in the field of solar-terrestrial physics.

Prof. C. N. R. Rao

The Shanti Swarup Bhatnagar Memorial Award for the year 1968 has been made to Prof. C. N. R. Rao for his outstanding contributions in the field of Chemistry.

Prof. Rao is a capable teacher and research worker and is at present Professor of Chemistry at the Indian Institute of Technology, Kanpur. In his early career he was associated with important centres of advanced research in chemistry, namely the Indian Institute of Science, Bangalore; Purdue University; and the University of California, Berkeley, USA, and he had all through a brilliant academic record. His early research work related to the application of spectroscopic methods for the study of chemical compounds, the main emphasis being on UV and IR spectra. Besides reviews and books he has published a large number of original papers.

His more recent work that has been valued for the Bhatnagar Award relates to solid state chemistry and constitutes a valuable contribution to this important field. In this area also he has published a number of reviews and books and a large number of original papers.

In appreciation of his contributions to physical chemistry he was awarded the Marlow Medal of the Faraday Society for the year 1967. He has taken part in many international conferences and is the leader of an active school of research.

Dr T. A. Venkitasubramanian

The Shanti Swarup Bhatnagar Memorial Award in Biological Sciences for the year 1968 has been made to Dr T. A. Venkitasubramanian for his outstanding contributions in the field of Biochemistry.

Dr Venkitasubramanian is Head of the Department of Biochemistry, Vallabhbhai Patel Chest Institute, University of Delhi. Dr Venkitasubramanian has been the first investigator in India to initiate and carry out systematic investigations on the lipid metabolism of different strains of tubercle bacilli. His researches on experimental tuberculosis have added significantly to the knowledge of the biochemical pathology of the disease. These investigations help in early diagnosis of tuberculosis and in evolving effective chemotherapeutic agents.

Studies carried out by him on cheap and commonly available plant proteins have useful implications in the problem of protein malnutrition.

Another important contribution of Dr Venkitasubramanian is the development of new and simple laboratory techniques for the analysis of biologically important compounds. Dr Venkitasubramanian has a large number of publications to his credit.

Dr K. R. Chakravorty

The Shanti Swarup Bhatnagar Memorial Award for the year 1968 has been made to Dr K. R. Chakravorty for his outstanding contributions in the field of Chemical Engineering.

Dr Chakravorty is at present Managing Director, Fertilizer Corporation of India Ltd. His pioneering contributions are in the development of indigenous process know-how and products, leading to import substitution and building up of indigenous capacity and expertise for planning, design and engineering of large scale fertilizer and heavy chemical plants. Particularly notable among these is the development of know-how for the entire range of fertilizer catalysts and their manufacture in the country. These catalysts have been developed on the basis of a new theory on the mechanism of catalysis propounded by him, and the integration of this know-how in the design and engineering of fertilizer plants. This breakthrough has directly led not only to the establishment of the fertilizer industry on a technologically self-reliant basis but has also, in its wake, given an impetus to increased indigenous fabrication of machinery and equipment for fertilizer plants.

Dr Chakravorty has been personally responsible for building up the Planning & Development Division of the Fertilizer Corporation of India into a comprehensive and integrated multi-functional organization. It encompasses the various interrelated and interlinked functions of not only laboratory research, pilot plants, project planning, design, engineering, procurement, installation and commissioning of fertilizer plants but also agronomical research, application and promotional activities for finished fertilizers in the country; this has rendered possible self-sufficiency in all disciplines of the fertilizer industry in its entirety.

In the field of project planning, techno-economic feasibility studies and project reports for almost all the fertilizer projects in the country have been made with his direct participation and supervision. Besides these project reports, 34 papers have been published by him on various aspects of the fertilizer industry. He is also the author of 14 works in fundamental science, wherein a new unified field theory has been propounded.

Dr Chakravorty has 27 patents to his credit. He is a life member of the Indian Institute of Chemical Engineers. He was awarded Padma Shri in 1954.

Dr S. R. Mukherjee

The Shanti Swarup Bhatnagar Memorial Award for the year 1968 has been made to Dr S. R. Mukherjee for his outstanding contributions in the field of Medicine.

Dr Mukherjee, Professor-in-charge, Department of Experimental Medical Sciences, Institute of Post-graduate Medical Education and Research, Calcutta, has to his credit studies on homeostasis of blood pressure, hypothermia, iodine metabolism, marsiline, epilepsy, Brahmi, healing of fractures, and Prasarani.

Studies carried out under the guidance of Dr Mukherjee have opened a new field of work in medical science with reference to the problems in learning disorders in neuropsychological and neuropsychiatric aspects.

Dr Mukherjee is the author of a large number of original research papers. He is a Fellow of the Indian Academy of Medical Sciences. He was awarded the Coates medal by the Calcutta University for his outstanding contributions in medical science.

Dr U. K. Sheth

The Shanti Swarup Bhatnagar Memorial Award for the year 1968 has been made to Dr U. K. Sheth for his outstanding contributions in the field of Pharmacology.

Dr Sheth, Professor and Head, Department of Pharmacology, Seth G. S. Medical College, Bombay, is widely regarded as the first Indian pharmacologist who has thrown himself whole-heartedly in the study of clinical pharmacology. He is deeply interested in undergraduate education and enjoys a high reputation in the profession.

Dr Sheth is the author of a large number of publications both in national and international journals in the field of pharmacology. He is a Fellow of the Indian Academy of Medical Sciences.

Dr A. N. Mitra

The Shanti Swarup Bhatnagar Memorial Award for the year 1969 in Physical Sciences has been made to Dr A. N. Mitra for his contribution in the fields of Theoretical Nuclear Physics and the theory of Hadron Resonances.

Dr Mitra is at present Professor of Physics at the University of Delhi. His pioneering work on the nuclear three-body problem, for which he was the first to obtain an exact solution in terms of separable potentials, has received international recognition. This work of Dr Mitra has generated a good deal of interest in the nuclear physics world and has been extensively quoted in the literature.

In the field of hadron physics, Dr Mitra first showed the incompatibility of Fermi statistics for quarks with the observed monotonic behaviour of the proton form factor with momentum transfer. He also gave a new classification of hadron resonances in terms of s-wave quark-quark forces in conformity with the observed pattern of 56 (even) and 70 (odd) representations of the group $SU(6) \times 0(3)$, and their Regge recurrences. He has also developed a comprehensive phenomenological theory of relativistic interactions of hadron resonances with vector and pseudoscalar mesons in terms of the quark model. All these contributions have been received well, and extensively quoted in books, journals and many international conferences.

Dr Mitra is a fellow of the Indian National Science Academy and of the Indian Academy of Sciences. He was for several years an Associate Member of the International Centre for Theoretical Physics, Trieste and has recently been conferred a Senior Associateship of this Institute.

Prof. A. C. Jain

The Shanti Swarup Bhatnagar Memorial Award for the year 1969 has been made to Prof. A. C. Jain for his outstanding contributions in the field of Chemistry.

Prof. Jain is at present Professor and Head of the Department of Chemistry in the University of Jammu where he has successfully organized a team of workers in the field of natural products chemistry. After a bright academic career he did research work at well known centres for the study of natural products, namely Delhi University, Cambridge University, and the Institute of Organic Chemistry, Moscow; he is a graduate of all the three universities.

His early research work relates to the chemistry of natural products, especially polyphenolics. His approach has been largely synthetic, though he has also examined a number of important plants for their chemical components and elucidated their structures. In recent years he has evolved new and useful methods for the synthesis of polyphenols. Among them are important isoflavonoids occurring in nature and the related group of 3-phenyl-4-hydroxycoumarins which are found in many *Derris* roots in place of the earlier well known and more toxic rotenoids. They include several compounds that contain terpenoid side chains and rings. The serious difficulties involved in their synthesis have been effectively solved.

Prof. Jain has published a large number of original papers in various national and international journals and has taken active part in several international conferences. He has more recently initiated research in organic photochemistry, a field of current interest with great potentialities.

Prof. S. Kalyanaraman

The Shanti Swarup Bhatnagar Memorial Award for the year 1969 has been made to Prof. S. Kalyanaraman for his outstanding contributions in the field of Neurosurgery.

Prof. Kalyanaraman, Additional Professor of Neurosurgery, Institute of Neurology, Madras Medical College, Madras, was able to establish the position occupied by the pyramidal tract in the internal capsule and has successfully used stereotaxic surgery in the treatment of Parkinsonism. He was also successful in producing bilateral stereotaxic lesions and in demonstrating that these mirror lesions are not harmful.

Prof. Kalyanaraman is the author of 186 original research papers. He is a member of several learned societies. He was the first neurosurgeon in India and Britain to be awarded the Ph.D. degree in neurosurgery. He has been the recipient of a large number of medals, prizes and certificates.

Dr Ranjit Roy Chaudhury

The Shanti Swarup Bhatnagar Memorial Award for the year 1969 has been made to Dr Ranjit Roy Chaudhury for his outstanding contributions in the field of Reproductive Biology and Hormonal Mechanism in the Genesis of Oedema.

Dr Chaudhury, Professor of Pharmacology, Post-graduate Institute of Medical Education and Research, Chandigarh, has made a significant contribution by demonstrating that interference in the release of histamine from most of the cells may be one of the modes of action of the intrauterine contraceptive devices. He is the author of 50 original research papers.

Shri T. V. Ananthan

Shri T. V. Ananthan has been appointed Director, Bombay Textile Research Association (BTRA), Bombay, with effect from 1 April 1972.

Shri Ananthan (born 12 May 1927) had a brilliant academic career at the University of Bombay and obtained his B.Sc. (Hons) degree in 1947, and Bachelor of Textiles (Text.) degree with distinction in 1951. After serving for a short period in the textile industry, he joined the Faculty of the Textile Manufactures Department, Victoria Jubilee Technical Institute (VJTI), Bombay. In 1953, he was awarded a fellowship under the Colombo Plan for South and South East Asia, which enabled him to proceed to Australia and obtain a post-graduate fellowship of the Gordon Institute of Technology (F.G. Institute Tech.) in the field of textiles. On his return to India, he was appointed Reader in Weaving, University of Bombay, at the Textile Manufactures Department, VJTI.

Joining BTRA in 1958 as Liaison Officer, he became Assistant Director and later Chief Textile Technologist of the Mechanical Processing Division.

Shri Ananthan has published more than 30 research and technical papers. He is a recognized post-graduate guide of the University of Bombay for the degree of Master of Textiles (M.Text.). As an Exchange Scientist under the India-USA Exchange of Scientists and Engineers Programme, in August 1968, he acquainted himself with latest trends in textile research and machinery developments in USA, UK and Europe.

Shri Ananthan was the principal investigator of a five-year research project concerned with the study of factors affecting curling and bursting of preponderantly warp and filling-faced cotton fabric structure during processing. This project, sponsored at BTRA by United States Department of Agriculture PL 480 authorities, provided valuable data needed for improving the processing of cotton into end use products.

Shri Ananthan has been actively associated with the Textile Association (India); Textile Institute (Manchester), Bombay Section; and the Indian Standards Institution. He is a nominee of the Maharashtra Government on the Board of Directors of the Maharashtra Co-operative Spinning Mills Federation. He has made significant contributions to the technology of spinning and weaving, and provided effective consultation service to the industry, as a result of which he has received considerable appreciation from the member mills of BTRA.

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Symposium on Prestressed Concrete Pipes, Poles, Pressure Vessels and Sleepers

An international symposium on Prestressed Concrete Pipes, Poles, Pressure Vessels and Sleepers, organized by the Structural Engineering Research Centre, Madras, and co-sponsored by a number of other institutions in the country, was held at Madras from 14 to 16 February 1972. The Federation Internationale de la Precontrainte, France, collaborated in organizing the symposium.

The deliberations of the symposium were held in four technical sessions—one each on Sleepers, Poles, Pipes, and Pressure Vessels, followed by a concluding session. Thirty-three papers, including ten from other countries, were presented at the symposium which was attended by about 270 delegates. A brief account of the proceedings of the symposium follows:

Pipes

Four papers were presented and discussed at the session on pipes. The discussions focussed attention on the problems facing the prestressed concrete pipe industry in India. These included design criteria, choice and development of manufacturing methods, performance and durability of the pipes.

The chairman of the session Dr E. W. Bennett, of the Univerity of Leeds, made a significant suggestion that research institutions in India should not confine themselves merely to mathematical analysis, but should devote attention to the problems of manufacture, quality control and durability of pipes. The discussions at the session revealed the inadequacy of data on loading standards, plant engineering and process designs in India, and hence the need was felt for laying emphasis on the development of such technologies in the manufacture and use of prestressed concrete pipes.

Poles

Discussions at the session pointed to the need for developing transport and handling equipment to enable industrialization of the production of prestressed concrete poles and their use. It was recommended that partially prestressed concrete poles should be accepted as an alternative design with the advantage of savings in high tensile steels and that efforts should be made to utilize prestressed concrete elements for high voltage transmission line towers. It was also suggested that the Ministry of Industrial Development should give licenses for the production of larger quantities of high tensile steel wires.

Pressure Vessels

Discussions at this session brought to light the following points:

(1) Double containment concept used for the perimeter wall of the Kalpakkam vessel may be extended with advantage to the dome also.

(2) A certain amount of evolution of construction method is necessary to reduce the wall thickness of the pressure vessels.

(3) Use of heavy tendons to reduce congestion and use of slip forming to reduce the depths of pouring will improve homogeneity and speed up the construction.

(4) Grouting of prestressing ducts will improve the leak tightness characteristics of the vessel.

(5) Steel liners for the containment vessels become necessary only if the design pressures are increased and leakage requirements are made more severe.

Sleepers

Twenty papers were presented in this session. Deliberations at this session highlighted the following points: (i) use of high grade cement to minimize the variability in strength; (ii) use of stranded wire to increase bond in the mass production of sleepers; (iii) need for theoretical and experimental studies on the distribution of stresses and loading conditions on the sleepers; (iv) use of partial prestressing for improving the designs; (v) use of statistical quality control, improved compaction and steam curing methods to achieve consistency in quality; and (vi) a review of acceptance criteria and reduction of rejection rates to make production in the factories viable. It was also felt that the Government of India should encourage the setting up of factories for prestressed sleepers, especially at the initial stage of development of the technology.

The recommendations and suggestions made at the concluding session stressed the need for intensifying the R & D efforts in the field of prestressed concrete products and the setting up of industrial units. The session emphasized, for instance, the need for (i) setting up a large number of medium and large factories for the production of prestressed concrete products; (ii) undertaking studies on the corrosion of prestressed concrete pipes, and leakage; (iii) use of polymer concrete in prestressed concrete works; and (iv) use of crimped wires and high tensile deformed bars as alternatives to high tensile wires in the production of sleepers.

It was estimated that the quantity of poles required in the coming 5 years will be 4 million units, and a recommendation made in this regard called for intensification of standardization work in respect of concrete poles by the Indian Standards Institution in coordination with the Rural Electrification Corporation.

Other recommendations related to the study of the optimum shape of poles, development of portable pretensioning, and development of an indigenous system of manufacture of pipes.

Treatment and Disposal of Tannery and Slaughter House Wastes

A seminar on Treatment and disposal of Tannery and Slaughter House Wastes was arranged at the Central Leather Research Institute (CLRI), Madras from 1 to 4 February 1972 as part of the Leather Week organized by the institute.

Twenty papers were presented in the following four sessions: (i) Tannery effluents—characterization and pollution effects; (ii) Tannery effluents—treatment and disposal; (iii) Slaughter houses—waste treatment; and (iv) Hygiene and public health in slaughter houses including maintenance. Brief accounts of some of the papers follow.

The results of effluent surveys carried out in three tanneries in Madras for assessing the quality and quantity of wastes let out from different operations were dealt with in the paper presented by V. Kothandaraman, P. Murahari Rao and C. A. Sastry of the CPHERI Zonal Laboratory, Madras. The quantity of waste water let out varied from 3008 to 3324 litres/100 kg of hides processed per day. It was found that liming liquor and vegetable tanning liquors are the most polluting wastes emanating from any tannery. Laboratory studies have indicated that continuous sedimentation tanks designed on the basis of maximum hourly flow and having a detention time of 4 hr would be suitable for reducing the pollution load due to tannery waste to a certain extent.

In their paper 'Characteristics of wastes from tanneries in Kanpur', H. C. Arora, S. N. Chattopadhyaya and V. P. Sharma (CPHERI Zonal Laboratory, Kanpur) outlined the various steps involved in the processing of skins and hides with reference to the quantity of waste discharged. The paper also included a general pattern of flow of waste waters from tanneries in Uttar Pradesh, their composition and pollution effects.

The toxicity of effluents from vegetable tanneries has been investigated by A. V. S. Prabhakara Rao and M. Mariappan (IIT, Kanpur) using freshwater fish *Catla catla*. Liming waste containing sulphides and deliming waste containing ammonia were found toxic; the latter was more toxic than the former.

In the second session, the paper by C. A. Sastry, V. Kothandaraman and P. Murahari Rao (CPHERI Zonal Laboratory, Madras) outlined some of the principles of low cost waste treatment methods such as oxidation ponds, oxidation ditches and aerated and anaerobic lagoons and their applicability in treating tannery wastes. G. M. Saxena (Indian Standards Institution, New Delhi) covered in his paper standardization work done during the last 15 years by ISI on the prevention of water pollution. A series of standards covering such aspects as steam quality, effluent quality, methods of sampling and testing have been evolved by ISI. A reference was made to IS: 5183-1969—Guide for the treatment of effluents of tanning industry —which contains information on the characterization of tannery effluents, their pollutional effects and methods for treatment and disposal.

Primary treatment of tannery wastes is by screening, settling basins and lagoons with controlled volume discharge. However, a recent trend in this direction is to subject the effluents to biological treatment processes for producing an effluent which could be discharged into a receiving stream. Trickling filters and activated sludge processes have been tried, and these are however very expensive for small tanneries. B. B. Sundaresan and N. K. Chengappa (College of Engineering, Madras) presented the results of studies conducted with intermittent sand filters which could be employed by small tanneries.

Of the four papers presented in the third session, three were from CPHERI zonal laboratories. The nature and composition of slaughter house and meat packing wastes in India and other countries and the water pollution problems associated with them were discussed by C. A. Sastry (CPHERI Zonal Laboratory, Madras). The need for treating these wastes was stressed, and the standards prescribed by ISI for the discharge of industrial wastes into inland streams, sewers and on to land were described. The need for byproduct recovery in slaughter houses was emphasized. The results of studies on the treatment of slaughter house wastes by anaerobic filters were presented in their paper by S. K. Shrivastava and A. K. Seth (CPHERI Zonal Laboratory, Delhi).

A number of diseases prevalent in livestock are common to both animals and human beings. They can be classified as viral, bacterial, fungal and arthropod diseases which can get communicated through hides and skins. According to the paper presented by R. Bhaskaran (CLRI, Madras) in the fourth session, major diseases to be considered from the point of view of tannery hides and skins and effluents are anthrax caused by *Bacillus anthracis*, pox and foot and mouth diseases among the viral diseases, and ring worm, the fungal infection.

For improving the present conditions of the slaughter houses and to guide construction of new slaughter houses, an Indian Standard on Basic Requirements for an Abattoir (IS:4393-1967) has been formulated. This standard (M. T. Satwani; ISI, New Delhi) prescribes typical layouts, hygienic requirements and basic requirements for an abattoir. A comprehensive code of practice for ante-mortem and post-mortem inspection of meat animals has been formulated by ISI for the guidance of municipal corporations, meat processing factories and slaughter house authorities. It has been emphasized that these standards, if scrupulously implemented, could play a vital role in the development of slaughter houses and meat industry in the country.

An important outcome of the seminar was the setting up of two expert panels in regard to: (i) Methods of treatment and disposal of wastes; and (ii) Slaughter house maintenance, wastes, hygiene and public health. The panels have made certain recommendations in the light of the deliberations at the seminar.

Recommendations

Methods of Treatment and Disposal of Tannery Wastes

(1) The panel considered the problem of tannery wastes disposal in the different regions of the country and came to the conclusion that in spite of the variations in the processing of hides and skins and in the characteristics of the effluents among different tanneries, all tannery wastes have high BOD and suspended solids, in addition to certain other objectionable constituents. Hence, it urged tanneries to take effective steps to remove the polluting constituents to the required degree.

(2) The panel felt that the recommendations of the Indian Standards Institution (IS : 5183-1969) should be adopted by the tanneries.

(3) As an immediate first step, the composite tannery wastes should be screened to remove all solid matter such as fleshings and hair and the screened wastes should be subjected to sedimentation. The sludge is to be dried on sludge drying beds and then disposed of as manure. Treatment up to this stage should be carried out by all the existing tanneries, small or large.

(4) If the local situation warrants, the salt-laden effluents from soaking and pickling operations should be segregated and allowed to evaporate in impervious ponds. Attention should also be given by the tanneries to the practice of dusting off the salt from hides and skins and disposing of the salt in a dry state in an innocuous manner.

(5) Where small tanneries are operating in a cluster, the possibility of setting up a common treatment plant should be explored. This would reduce the cost of treatment.

(6) Wherever a municipal sewer is available, the settled tannery wastes may be permitted to be disposed of into the sewer, subject to the conditions prescribed by the municipal authority.

(7) Where municipal sewers are not available, tannery wastes will have to be disposed of on land or into a water course. In case the disposal is to be done on land, the settled effluent should be given further treatment so that it complies with the provisions of IS : 3307-1965. For this purpose, the panel recommended that anaerobic and/or aerobic treatment should be carried out.

(8) In regard to the disposal of tannery wastes into inland surface water, the panel observed that further treatment beyond that mentioned in recommendation 7 will be necessary in order that the provisions of IS : 2490-1963 are complied with. The exact treatment required in this case would vary from tannery to tannery, and the panel considered it preferable that in this case the tanners are provided detailed assistance by CPHERI, CLRI, the King Institute and public health authorities in establishing the design criteria. The panel hoped that these laboratories, in collaboration with the concerned tanneries and their regional associations, will carry out pilot plant studies wherever needed, and based on the results of such studies set up demonstration plants in suitable areas.

(9) For tanneries to be set up in future, or in the expansion of existing tanneries, public health authorities should ensure in advance that provisionfor adequate treatment of the wastes has been made.

Slaughter House Maintenance, Wastes, Hygiene and Public Health

The panel made 13 recommendations in all with regard to slaughter house maintenance, wastes, hygiene and public health. The panel considered proper byproduct utilization and treatment of slaughter house effluents as a primary requisite. The stomach and intestinal contents may be utilized for fuel gas production. Spent cow dung may be utilized as manure.

The panel also suggested that the possibility of making compost manure using slaughter house wastes economically should be studied. A sample survey of economic losses in slaughter houses due to non-utilization of certain products or byproducts is necessary. Hygienic disposal of slaughter house waste should be considered while planning modern slaughter houses.

Polarographic Behaviour of Some Metal Ions in Sulphosalicylic Acid

Complexes formed by the metal ions such as Mn^{2+}, Mn^{3+}, Co^{2+}, Co^{3+}, Ni^{2+}, Cu^{2+}, Zn^{2+}, Ti^{3+}, and Mo^{3+} with sulphosalicylic acid have been studied polarographically and in some cases by ion-exchange technique by Shri A. D. Parulekar at the National Chemical Laboratory, Poona, under the guidance of Dr P. R. Subbaraman.

The redox behaviour of Mn(III)-Mn(II) couple in sulphosalicylic acid is reversible. Mn(II) forms a 1 : 1 complex with sulphosalicylic acid above *p*H 7·0. The complex is unstable in air and is rapidly and quantitatively oxidized to Mn(III) complex with a metal-to-ligand ratio of 1 : 2. Though Mn(II) complex hydrolyzes above *p*H 9·0, Mn(III) complex withstands hydrolysis up to *p*H 11·0. If Mn(III) complex in alkaline sulphosalicylic acid is gradually acidified it decomposes till finally at a *p*H around 7·0 all Mn is in uncomplexed Mn(II) state. In this process of reversion of Mn(III) complex to Mn(II) aquated ion the ligand is oxidized to a product reducible at DME. From polarographic data log k_1 for the formation constant of Mn(II) complex and log k_1 k_2 for the formation of Mn(III) complex have been computed as 5·24 and 20·60 respectively.

A selective method for the polarographic determination of Mn in the presence of other divalent cations such as Co, Ni and Zn has been developed.

The Co(II) waves in sulphosalicylic acid are ill defined and irreversible, the irreversibility increasing with *p*H. Co(III) complex is obtained by oxidation of Co(II) with H_2O_2. The colour is deep green when the ligand is in excess and brownish at lower concentrations of ligand. When excess H_2O_2 is removed from the solution, part of Co(III) appears to revert to Co(II). The polarograms of Co(III) complex show a dip on the plateau of the Co(III) wave, which increases with ligand concentration. The suppression or total elimination of this minimum by the increase of ionic strength and/or by bulky cations such as caesium suggests that the minimum has its origin in the electrolytic repulsion between the negatively charged Co(III) complex species and the negatively charged electrode.

A Co(III) complex salt of the composition Na [Co (sal)$_2$ (Py)$_2$]. 2H$_2$O has been isolated from a solution containing salicylic acid, in place of sulphosalicylic acid and pyridine. An aqueous solution of this salt gives a clean polarogram with no minima and with the Co(II) and Co (III) waves in the correct ratio of 1:2. The polarogram further shows that the Co(II) does not exist in the form of a mixed ligand complex unlike the Co (III), but is present partly as the Co-pyridine complex and partly as Co-salicylate complex, giving separate polarographic waves for each.

Copper(II) forms 1:1 and 1:2 complexes with sulphosalicylic acid. Like the Co(III) complex species, the Cu(II) 1:2 species also shows a dip on its diffusion plateau, and perhaps for the same reason. The waves for 1:1 species are reversible (log k=9.57).

The waves of Zn(II) are quasi-reversible and well developed up to a pH of 8·0; above this pH, the cathodic wave breaks into two or more steps with further increase in pH. Interpretation of these polarograms is somewhat difficult, but participation of hydroxyl ions in coordination is indicated.

The catalytic currents obtained in the presence of oxidants such as perchlorate, nitrate and chlorate in case of molybdenum and titanium and their suppression with sulphosalicylic acid have been used to evaluate the composition and formation constant of Ti^{3+} and Mo^{3+} with sulphosalicylic acid.

The formation constants of the complexes of Ni(II), Cu(II), Zn(II) and Co(II) with sulphosalicylic acid have been determined using the ion-exchange equilibration technique. A cation exchange method for the separation of iron from manganese present in widely different ratios has been developed.

Shri Parulekar was awarded the Ph.D. degree of the Poona University, Poona for his thesis based on the studies.

PROGRESS REPORTS

RRL, Hyderabad Annual Report: 1970-71

Standardization of conditions for efficient hulling of sunflower seeds to obtain good quality oil and light coloured cake, development of a new method for refining and deodorization of sardine oil, production of an anticorrosive paint and pentaerythritol, and test-marketing of silicon carbide are the highlights of the work of the Regional Research Laboratory (RRL), Hyderabad during 1970-71. The annual report (royal 8vo, 73 pages) of the laboratory, published recently, records the progress of the work under the following main areas of R & D work in which it is engaged: Oils and fats; Surface coatings; Organic chemicals and pesticides; Cellulose and paper; Entomology; Biochemistry; Coal; Mineral products and inorganic chemicals; Industrial ceramics; X-ray crystallography; Instrumentation; Chemical engineering and General engineering.

Methods for the utilization of indigenously grown sunflower seeds were explored and conditions were standardized for efficient hulling and expelling to obtain good quality oil and light coloured cake. The kinetics of continuous hydrogenation of coconut oil over fixed-bed catalysts was determined for the production of fatty alcohols using a new catalyst based on copper-zinc, which shows a long life and gives a total yield of 95% alcohols in two passes. A method has been worked out for refining and deodorization of sardine oil by solvent extraction. Sardine oil, which is widely used in surface coating, printing ink and leather industries, is estimated to be available to the extent of 10 000 tonnes/annum.

Polyurethanes are not produced in India. The laboratory has prepared urethanes from sardine oil using various polyols which are comparable to those prepared from DCO and linseed oil alkyds. Successful formulations are being made in larger amounts for evaluating their use in paints.

An anticorrosive paint prepared by the laboratory using barium phosphate pigment in place of basic lead sulphate has been found to be satisfactory in service trials carried out by the Shipping Corporation of India. A new method has been developed for the determination of critical pigment volume concentration by the measurement of the dielectric constant of pigment-oil mixtures.

Know-how has been developed for the production of pentaerythritol—an important intermediate for the manufacture of synthetic resins and explosives. One of the N-aralkylanthranilic acids, which earlier showed promising anti-inflammatory, analgesic and antipyretic action in experimental animals, was put through clinical trials and tried on patients suffering from rheumatoid and rheumatic arthritis, osteoarthritis and trauma with encouraging response. Improvements were effected in the processing conditions of pitch-bound char briquettes to reduce the time taken for desmoking. The time required for the production of strong, smokeless briquettes using 10 and 12% soft pitch as binder was reduced to 2-3 hr and 4-5 hr respectively as against 6-8 hr and 12-14 hr taken earlier.

Silicon carbide produced during furnacing operations has been test-marketed and has found ready acceptance by the consumer industry in the production of coated and bonded abrasives, precision grinding and lapping powders, lightning arrestors and varistors. Furnacing operations have at the same time helped in improving the yields and efficiency and have given the necessary data for designing a commercial plant. The process has been released to Indian Metals and Ferro Alloys Ltd, Bhubaneswar.

Obtusifoliol has been isolated for the first time from the root heartwood of *Soymida febrifuga* (Meliaceae). Syringetin and dihydrosyringetin—two new flavonoid pigments—were isolated and characterized.

In view of the increasing interest in the industrial application and biological properties of sulphur containing heterocyclic systems, the laboratory has taken up studies on the chemistry of thia- and dithia-indanones—a hitherto uninvestigated class of compounds.

Earlier work has given a lead in the synthesis of quinazolone compounds. Various modifications tried on the parent 4(3H)-quinazolone moiety with a view to obtaining newer compounds have yielded some compounds possessing interesting physiological action.

Insect-repelling properties of five essential oils, viz. palmarosa, lemongrass, gingergrass, eucalyptus and sandalwood, have been studied. Palmarosa oil has been found to be the most effective followed by lemongrass and eucalyptus oils. At very high concentrations, palmarosa and gingergrass oils produced knockdown effect within 10 min, and often the flies did not recover.

Process know-how for the following six processes was released to industry: manufacture of silicon carbide, high protein flour from cottonseed, activated carbon from pine char-coal, products from sal seeds, glass-sealed terminals and black disinfectants.

The process know-how for the manufacture of benzyl cyanide, benzyl alcohol, benzyl acetate, anhydrous calcium sulphate, papain concentrate, papain B. P. and active carbon was demonstrated to the licencees.

Sponsored work on the production of diketene, 5-chloro-7-iodo-8-hydroxyquinoline, aluminium hydroxide gel and perfumery chemicals was completed and data were provided to the sponsors.

Sixty-three research papers were published, two patents were filed, three were accepted and four were sealed.

CSIR SUPPORT TO RESEARCH

New Schemes

Chemical Investigation of *Tricosanthes dioica*

Tricosanthes dioica Roxb. (Cucurbitaceae), a plant cultivated for its edible fruits, is found in the plains of north India extending to Assam. The leaves and roots of the plant are known to possess medicinal properties. Chemical examination has revealed that the roots of the plant contain an amorphous saponin; hentriacontane; a phytosterol; a non-nitrogenous bitter principle; small amounts of essential oil; a little fixed oil; and traces of tannins. But no attempts have been made to isolate the saponin, phytosterol or the bitter principle in a pure state and characterize the compounds. Under a new CSIR research scheme sanctioned at the Chittaranjan National Cancer Research Centre, Calcutta, Dr S. K. Chakraborti (principal investigator) proposes to isolate in a pure state the more important constituents of *T. dioica* (roots and leaves), elucidate the structures of the constituents and evaluate their anti-tumour activities.

Ion Exchange Properties of some Inorganic Solids

The rapid development of nuclear power has highlighted the importance of macro and micro-chemical separations of intensely radioactive inorganic materials. In view of the instability of organic resins under drastic experimental conditions, their use in separating radioactive substances is limited; as a consequence, more attention is being paid to the stable inorganic ion exchangers. Under a new CSIR research scheme granted to Dr K. R. Kar (principal investigator), of the Department of Chemistry, Delhi University, Delhi, it is proposed to study the diffusion and exchange of a few hydrous oxides of certain multivalent metals in solid-liquid systems and to correlate the measured properties with the structures of the exchangers. This knowledge would be useful in developing new procedures for the disposal of radioactive waste materials and for chemical processing of fission products.

Biochemical Studies on Antimetabolite Resistance

That microorganisms can be made resistant to antimetabolites has been observed with respect to amethopterin, pantoyltaurine, sulphonamide, sulphathiazole, pyrithiamine, penicillin, streptomycin, etc., and this has been associated with changes of biochemical characteristics. In the case of pyrithiamine resistance the antimetabolite which acts as a mutagen is structurally altered before it is utilized. The antimetabolite is deaminated in the 4′ position and this new compound, oxypyrithiamine, which is not a competitive inhibitor of thiamine, is found to be a growth inhibitor of the parent *S. aureus*. The role of oxypyrithiamine, which alters the genetic characters of the mutant strain and hence the metabolic process of the organism, is not clearly known.

To get a clear picture of the mechanism of resistance with respect to this antimetabolite is the objective of a new CSIR scheme sanctioned to Dr G. C. Chatterjee (principal investigator) at the Department of Biochemistry, University College of Science, Calcutta. The work will involve: (1) studies on the metabolic fate of oxypyrithiamine in the pyrithiamine mutant strain; (2) transformation studies to know whether the resistance factor is carried by episome; and (3) studies on the nucleic acid metabolism in the resistant strain.

Chemotherapeutic Agents

Under a new CSIR research scheme sanctioned to Dr O. P. Singhal (principal investigator), of the Department of Chemistry, St John's College, Agra, it is proposed to synthesize compounds possessing anti-tubercular, antiviral, anti-filarial and hypoglycemic activity. The chemotherapeutic properties of these compounds will also be evaluted.

Collector Action of Chelating Agents

Chelating agents are a class of substances which react chemically with specific metal ions forming a highly insoluble metal complex. A large number of these possess heteropolar structure consisting of a nonpolar group which is essentially a hydrocarbon chain. By virtue of their specificity and selectivity in forming metal-ion complexes, chelating agents find wide use in mineral flotation. This depends on their reaction with the metal ion present at the mineral surface and consequent creation of a hydrophobic film which renders the mineral particle flotable. No systematic study has been made to correlate the physico-chemical properties, such as solubility and stability constants, of the chelate complexes with the flotability of the mineral.

In a new CSIR research scheme sanctioned at the Department of Chemistry, Indian Institute of Technology, New Delhi, Dr S. R. Rao (principal investigator) proposes to investigate the collector action of a set of chelating agents (hydroxamates and oximes) on certain minerals, viz. hematite, cobalt sulphide, chromite, molybdenite and scheelite. The main objective of the study is to evaluate the utility of the chelating agents in the selective separation of minerals by froth flotation.

Isolation of Insect Moulting Hormones from Indian Plants

Literature survey has shown that moulting hormones from insects are obtained in very poor yields (10 mg/ tonne), and hence extensive biological testing becomes difficult. However, the insect moulting hormones are isolated in better yields from plant sources. In India, no study has yet been made in regard to the isolation of insect moulting hormones, which provide excellent opportunities for commercial exploitation, especially in the manufacture of silk, regulation of insect growth, etc. In a new CSIR research scheme granted to him, Prof. A. B. Kulkarni (principal investigator), of the Department of Chemistry, University of Bombay, Bombay, proposes to undertake a systematic screening of Indian plants and develop methods for the isolation of moulting hormones and elucidation of their structure. The hormones will be biologically tested for their moulting activity.

Completed Schemes

Stresses and Deflections in a Layered Pavement System

The problem of layered pavement systems in which elastic moduli instead of being constant vary with stress has been analysed by Shri P. N. Kachroo, a CSIR research fellow, who worked at the Department of Civil Engineering, University of Roorkee, Roorkee. The study was made under the guidance of Prof. O. P. Jain, Prof. S. K. Khanna and Dr Jagdish Narain of the University. The analysis considers the posssibility of pavement materials possessing different elastic moduli in compression and tension and variation of elastic moduli with stress.

Experimental and theoretical evidence indicates that the difference between practice and the existing layered theory solutions is that in practice the surface deflections are higher, the pattern of deflections around a load is more concentrated and reduction in deflection with depth is more rapid than indicated by the theory. These differences appear largely due to the simplifying assumptions made in the layer theory. One of the assumptions of the theory is that elastic moduli for the layers of a pavement are constant. The elastic moduli in compression and tension are further assumed equal and independent of stress. Pavement materials, on the other hand, are known to have a much lower value of elastic modulus in tension than in compression. Further, experimental evidence indicates that the elastic modulus in any layer of a loaded pavement does not remain uniform but varies with the level of stress imposed. To reduce the gap between theory and practice, the above facts should be recognized and incorporated in the analysis of layered pavement systems. The present study is an attempt in this direction.

The results of the study suggest a practical approach for obtaining possible variations in elastic moduli with stress. Triaxial tests at various confining pressures have been used to establish variations in elastic modulus with stresses when horizontal stresses in the loaded pavement are compressive. These tests have been performed on triaxial specimens of bituminous concrete, soil cement, soil bitumen, soil and sand. From these tests, relationships expressing variations of the elastic moduli with confining pressures have been obtained for use in the analysis.

A test method based on the concept of thick hollow cylinder under internal radial pressure has been developed to study the stress-strain behaviour of pavement materials subjected to horizontal tension and vertical compression. In this method, hollow cylindrical specimens subjected to internal radial pressure have been tested to express variations in elastic moduli with stresses when the horizontal stresses in the loaded pavement are tensile. This stress condition is likely to occur in the upper layers of a pavement near the interfaces. These tests have been performed on hollow cylindrical specimens of bituminous concrete, soil cement and soil bitumen. Relationships expressing variation in elastic moduli with stress have been obtained and used subsequently in the analysis.

The theoretical analysis, which has to include the variations in elastic modulus with stress and also the possibility of elastic modulus in compression and tension being unequal, is not possible by Burmister's method. The finite element method, which offers a powerful technique for solving such complex problems, has therefore been used in the present study. In the analysis, non-linear material properties have been approximated in the solution by iterative technique; for each successive cycle of solution a value of modulus for each element corresponding to the state of stress calculated for that element in the preceding cycle is chosen. The entire process was done automatically and sequentially on a computer.

A finite element computer programme has been written for the computation of stresses and displacements. The computer programme consists of a main programme (MAIN) and four subroutines (SM, MATINV, SKLC, SOLN). No standard subroutine has been used. The programme, written in FORTRAN II language, was executed on IBM 7044. The programme may be used for the analysis of layered pavement systems composed of materials with linear or non-linear stress-strain behaviour.

The finite element analysis, which considers the possibility of pavement materials having different elastic moduli in compression and tension and also includes the variations in elastic moduli with stress, indicates that surface deflections are higher, deflection profiles have a sharper curvature, and the reduction in deflection with depth is more rapid than indicated by the analysis which assumes constant values of elastic moduli for the layers of a pavement. The results were found to compare well with similar observations reported by other investigators for differences between measured deflections and deflections computed by linear elastic theory. The comparison indicated that the proposed analysis is more realistic than the analysis which assumes constant elastic moduli for pavement layers. This has been further supported by comparing a few typical results of the proposed analysis with some field data.

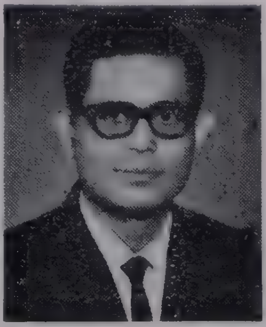
The comparisons with field data indicate that the surface deflection profile obtained by the proposed analysis is closer, in shape and extent, to the observed deflection profile than that predicted by Burmister's analysis. The maximum surface deflections given by the proposed analysis are found to be nearer to measured values than those calculated by Burmister's analysis. The variation observed in deflection with depth was found to resemble more the variation indicated by the proposed analysis than that predicted by the existing linear analysis.

For the load and material data used in the present study, an empirical correlation has been obtained between maximum surface deflections computed by the proposed analysis and Burmister's deflection values. This correlation was found to agree closely with a correlation reported between the observed surface deflections and deflections computed by the existing layered system analysis. The correlation indicates the extent of modification required in Burmister's deflection value to obtain realistic estimates of surface deflection on which design of pavements is generally based. The empirical correlation has been applied to deflections computed by Burmister's method for pavement model sections and compared with measured deflections. The modified deflection values were found to be quite close to the measured values.

For an accurate analysis of layered pavement system in which elastic moduli in tension and compression may not be equal and independent of stress, the finite element computer programme can be directly used with a high speed digital computer. The relationships expressing variations in elastic moduli, which are used in the computer programme, can be obtained experimentally as suggested in the present study.

Prof. P. K. Jena

Prof. P. K. Jena, of the Department of Metallurgical Engineering, Banaras Hindu University, Varanasi, has been appointed Director, Regional Research Laboratory, Bhubaneswar with effect from 1 May 1972.



Prof. Jena (born 27 December 1931) received his B.Sc. (Hons), M.Sc. and Ph.D. degrees in chemistry from the Utkal University. After completing his Ph.D. work, Dr Jena was awarded a scholarship by the University of British Columbia (Canada) for doing his master's degree in metallurgy. After successful completion of his studies in Canada he was appointed, in 1959, Scientist in the Atomic Energy Establishment (Bhabha Atomic Research Centre), Bombay. He served BARC for about 9 years in various capacities. In 1968 he joined the Department of Metallurgical Engineering of the Banaras Hindu University as Professor in Process Metallurgy.

Prof. Jena has specialized in physical chemistry and extractive metallurgy. He successfully organized at BARC a research and development group on extractive metallurgy. He has developed a number of processes for the beneficiation of minerals and extraction of refractory metals. Upgrading of ilmenite, preparation of tantalum, molybdenum, tungsten and ferroniobium are some of the significant contributions he has made in the field of extractive metallurgy of less common metals.

As Professor of Metallurgy at BHU, Prof. Jena has been successful in building up active schools of teaching and research in both fundamental and applied fields. His achievements in sponge iron production, winning of metals and alloys by sulphide-oxide reactions and upgrading of ilmenite are of special significance.

In recognition of his outstanding contribution to metallurgical research and education the Government of India conferred on him the National Metallurgists' Day Award in 1969.

Prof. Jena has published a large number of applied research papers in Indian and foreign journals. He has guided research work both in chemistry and metallurgy, leading to master's and Ph.D. degrees. He has been associated with a number of government and professional organizations.

International Symposium on Near Space Environment and Radio Communication

An international symposium on Near Space Environment and Radio Communication is proposed to be held at the National Physical Laboratory (NPL), New Delhi during 14-20 February 1973. To be held under the auspices of Radio Science Division of NPL and the National Oceanic and Atmospheric Administration, Boulder, USA, the symposium will deal with the following main topics:

(1) Description of Environment

Morphology of D, E and F-regions; outer ionosphere and plasmasphere; Photochemistry, ion composition and dynamics; Thermal structure of the neutral and ionized atmosphere; Earth's magnetic field variations, solar wind and cosmic rays

(2) Monitoring of Environment

Techniques of measurement:

(i) ground-based measurements; and

(ii) space techniques

(3) Environmental Disturbances—origin, propagation and their effects

Solar flare effects and solar radio emissions; Magnetic and ionospheric storms

(4) Environmental Effects of Electromagnetic Wave Propagation

Ionospheric propagation, tropospheric propagation, vlf atmospherics, whistlers, microwave communication, antenna theory, plasma electrodynamics, non-linear ionospheric effects and related topics; Prediction of environment; Ionospheric forecasting, tropospheric forecasting, and disturbance forecasting.

The proceedings of the symposium will be published as special numbers of the Indian Journal of Radio & Space Physics, being published by the Council of Scientific & Industrial Research, New Delhi.

The last date for the receipt of abstracts of papers is 30 September

1972. Intending participants may write to: Dr C.V. Subrahmanyam, Radio Science Division, National Physical Laboratory, New Delhi 12, for further information.

Thirteenth Seminar on Electrochemistry

The thirteenth seminar on electrochemistry is being organized by the Central Electrochemical Research Institute (CECRI), Karaikudi sometime during November-December 1972. Original as well as review papers on any branch of electrochemistry, including techno-economic data collected in the operation of electrochemical plants, under the following seven sections may be submitted for presentation at the seminar: (1) Electrothermics and electrometallurgy; (2) Electrokinetics, electrochemical equilibria and electro-analyses; (3) Corrosion; (4) Solid state electrochemistry; (5) Electrodeposition and metal finishing; (6) Batteries; and (7) Electro-organic and electro-inorganic products.

Abstracts and full papers should be sent by 1 July 1972 and 15 August 1972 respectively. Further information may be obtained from: The Director, Central Electrochemical Research Institute, Karaikudi 3.

Obituary

Sir Jehangir Ghandy

It is with deep regret that we record the passing away of Sir Jehangir Ghandy on 17 April 1972 in New Delhi. Sir Jehangir Ghandy was associated with CSIR in various capacities. He was a member of the Board and the Governing Body of CSIR for many years and brought to bear on the Governing Body his practical approach to scientific problems. Sir Ghandy was also for a long time chairman, and later member, of the executive council of the National Metallurgical Laboratory (NML), Jamshedpur. It was because of his deep interest in scientific research that CSIR acquired land and many other facilities from the Tatas for the establishment of NML. In shaping the policy of NML and making research an active component of industrial innovation Sir Jehangir played a dynamic role. He was also associated with the work of the Central Fuel Research Institute, Dhanbad as the chairman of its executive council.

As chairman of the CSIR Metals Research Committee since its inception he was interested in the development of metallurgical research in universities. One of his major interests was the prevention of metal corrosion and he was intimately associated with the Corrosion Advisory Bureau of the Metals Committee.

Sir Jehangir (born 18 Nov. 1896, Bombay) had a brilliant academic career. He graduated in 1916 and had his postgraduate studies in business administration at the Columbia University, New York, and in metallurgical and steel works engineering at the Carnegie Institute of Technology, Pittsburgh.

In 1921, he rejoined the Tata Steel Works at Jamshedpur as Metallurgical Engineer, and rose to the highest post – that of General Manager in 1938. For his outstanding work as an organizer, he was appointed Agent of Tata Steel in 1944. In 1945, he was appointed as Director of Tata Industries and, in April 1954, Director-in-charge of Tata Steel. A more significant recognition of his outstanding ability as one of the foremost administrators in the country came in August 1959 when he was appointed a Director of Tata Sons Pvt Ltd. Sir Jehangir retired from the Board of Tata Industries in 1964 but continued to be on the Board of Tata Steel till his death.

Sir Jehangir's activities covered a wide range, and recognition of his professional ability and his broad vision as a technocraft came from numerous quarters both within and outside the country. He was awarded Padma Bhushan in 1958.

Sir Jehangir, who was a Vice-President of the Indian Standards Institution (ISI), was elected President of the International Organization for Standardization (ISO) at the sixth Triennial Conference of the General Assembly of ISO held at Delhi in November 1964.

At a condolence meeting held jointly by ISI and CSIR on 19 April 1972, the Secretary, CSIR, who spoke on behalf of CSIR and Director General, Scientific & Industrial Research, said: "Sir Jehangir Ghandy may rightly be called one of the early builders of CSIR in succession to such great luminaries as Sir Ramaswamy Mudaliar, Sir Ardeshir Dalal and Dr S. S. Bhatnagar. We in the CSIR family are deeply grieved over the sad death of this towering personality in Indian industry and scientific research. We associate ourselves fully with all the tributes paid to him on the sad occasion and believe that the loss caused by his death will be hard to repair."

PATENTS SEALED

124000: An improved process for the preparation of alkyl nitrate esters from aliphatic alcohols, P. Desikan & K. K. Bhattacharyya—IIP, Dehra Dun.

124994: Improvements in or relating to nozzles for extrusion press in the manufacture of plastic products of complicated shapes by extrusion method, G. D. Joglekar & C. L. Verma—NPL, New Delhi.

134169: A strain gauge transducer, V. R. Singh, Ram Parshad—NPL, New Delhi.

121697: A process for production of surface active agents of the type of ester of fatty acid monoglyceride sulphonate, R. N. Mukherjea & A. Gupta—Chemical Engineering Department, Jadavpur University, Calcutta.

124367: A process for treating textile materials to impart high abrasion resistance, tear strength and retained breaking strength, V. B. Chipalkatti, N. B. Sattur & I. Hussain—SRIFIR, New Delhi.

124510: Improvement in or relating to the production of catalysts for the preparation of long chain fatty alcohols from fatty oils by continuous hydrogenolysis process, K. V. Raghavan A. J. Pantulu, K. Seshacharyulu & K. T. Achaya—RRL, Hyderabad.

124573: Improvements in or relating to the preparation of interpolymer compositions and ion-exchange membranes, K. P. Govindan & P. K. Narayanan—CSMCRI, Bhavnagar.

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CURRENT RESEARCH PROGRAMMES : RRL, HYDERABAD

The research and development programmes of the Regional Research Laboratory (RRL), Hyderabad for the year 1972-73 comprise 137 projects spread over several disciplines and multi-disciplinary areas. Of these, 78 are applied research projects including two projects investigated on pilot plant scale, and 36 projects are taken up under the sponsorship of industry or are worked out in collaboration with government organizations; 23 projects are of a fundamental nature. Brief accounts of the scope and objectives of major projects follow:

Inter-disciplinary Projects

Epichlorohydrin: This is an important raw material for the manufacture of epoxy resins, and is also used in the synthesis of glycerol derivatives, surfactants, lubricants and pharmaceuticals, and manufacture of castings, adhesives and ion-exchange resins. Although at present about 400 tonnes of epichlorohydrin are being imported annually, the projected annual demand including that of glycerol would be about 1000 tonnes in the near future. Routes for the various steps in its manufacture have been worked out, and process parameters like temperature, pressure, type of reactor, and concentration of reactants at each stage are being optimized. The project is sponsored by the Space Science and Technology Centre, Trivandrum.

Hydrogenation of benzene to cyclohexane: Cyclohexane is an important intermediate in the production of caprolactam, and is obtained by the hydrogenation of benzene. A catalyst for the conversion of benzene to cyclohexane has been developed and a 1-tonne/day pilot plant is expected to be set up in collaboration with the Gujarat State Fertilizer Corporation for upscaling the process.

Cyclohexylamine from cyclohexanol: Cyclohexylamine is used for the production of a variety of useful derivatives which find application in paper, rubber, plastics, pharmaceuticals, dyestuffs, insecticides and petroleum industries. Cyclohexylamine is manufactured by the reductive amination of cyclohexanol and the latter would be available in India from caprolactam plant. Work on the development of know-how for the conversion of cyclohexanol to cyclohexylamine has been taken up.

Hydrazine hydrate: Hydrazine hydrate finds use in the production of isonicotinyl hydrazide, in the manufacture of blowing agents for boiler water, in rocketry, and in the preparation of pesticides. The estimated demand for the chemical by 1973 is of the order of 500 tonnes/annum. The laboratory had earlier developed a process which is similar to the one at present in use in industry. The present work is aimed at improving the technology. Two routes, one of them starting from ketazine and the other from ammonia under pressure, are being tried. The route showing promise will be chosen for bench scale work.

Silicon carbide based products: Silicon carbide heating elements are used for industrial as well as laboratory heating up to temperatures of 1500° C, and are imported. Following the development of special type silicon carbide needed for making heating elements, laboratory and bench scale production is envisaged.

Cottonseed flour: Cottonseed flour is rich in proteins, especially the essential amino acid lysine, and is likely to become an extremely important source of proteins to meet the nutritional requirements of children and those depending on vegetarian diets. Investigations on hydrocyclone variables aimed at increasing the yields, and standardization of the method of preparation of low gossypol flour from seeds containing high gossypol glands are envisaged in this project.

Processing of soyabean: As soyabean is increasingly being cultivated in India there is need for the development of technology for its utilization. It is proposed to undertake the following studies: (i) direct extraction of indigenous soyabeans for the production of flour suitable for antibiotics industry; and (ii) use of pre-press solvent extraction method instead of the usual direct extraction method.

Oils and Fats

Hydrogenation of vegetable oils using catalyst activators: Studies have been undertaken to develop improved hydrogenation techniques with a view to economizing hydrogen use or minimizing the processing steps. It has been found that phosphoric acid has an accelerating effect on hydrogenation of refined groundnut oil. Studies are in progress to find its effect on crude oils.

Other projects under way in the field of oils and fats relate to: production of dibasic acids and ethenoxy derivatives from castor oil; modified fats; fatty amines; directed hydrogenation of cottonseed oil; sal fat pigments; pure methyl esters of fatty acids; glyceride structure changes during hydrogenation; and mould damage to safflower during storage.

Mustard: Processing of mustard seed with a view to obtaining maximum yields has not been attempted in a systematic manner. Studies will be undertaken on the refining, bleaching and hydrogenation of the oil and on the effect of allyl isothiocyanate present in the oil on the products. These studies are being undertaken under the sponsorship of the Jammu and Kashmir Industrial Development Corporation.

Surface Coatings

Silicones: Silicones are widely used in the production of speciality coatings, especially for aircrafts, rockets, heat-resistant purposes, etc., and the demand for these materials is met mostly through import. Preliminary work has been carried out on the preparation of polyorganosilanes starting from silicon tetrachloride and ethyl orthosilicate. Preparation of allyl chlorosilanes, allyl alkoxy silanes, phenyl chlorosilanes, and phenyl alkoxy silanes is also envisaged under this programme.

Polyurethanes: Because of their excellent performance, such as fast drying, good flexibility, excellent adhesion and high resistance to chemicals and abrasion, polyurethanes are extensively used in western countries in fabric coatings, wire enamels, coil impregnation varnishes, floor finishes, traffic paints, etc. Urethane oils prepared in the laboratory are intended to be used as media for preparing paints for different uses such as anticorrosive paints, wood and floor coatings, leather finishing, paper and textile coatings and traffic paints.

Other projects on which work is in progress relate to: coatings based on CNSL and cardanol; water-based vehicles and paints; speciality coatings; conversion of safflower oil to chemically reactive products of potential industrial value; and physico-chemical studies on surface coatings.

Organic Chemicals and Pesticides

β-Phenylethylamine: This is an important intermediate in the manufacture of drugs and pharmaceuticals, and is being imported. It has been produced by the hydrogenation of benzyl cyanide under pressure in the presence of ammonia dissolved in methanol. The yield and quality on the laboratory scale are satisfactory and bench scale work is in progress.

N-Aralkyl anthranilic acids and derivatives: One of the compounds of this class synthesized has shown anti-inflammatory activity in patients suffering from rheumatoid and rheumatic arthritis, osteoarthritis and trauma. Being non-steroidal in nature the compound is expected to find extensive use in the treatment of arthritis. Work on the chemical modifications of this molecule to get more potent compounds is in progress. Other projects under study are concerned with organic chemicals, potential pesticides, and development of process know-how in regard to two known important pesticides, namely Tedion and Methoxychlor.

Coal

Utilization of slack coal: During the mining of coal nearly 30% of it comes in the form of slack coal of less than 20 mm size. Proper utilization of the undersized coal is a major problem facing the non-caking coal industry. A modified open slack carbonization method, which consists in maturing with preheated air followed by carbonization, has been developed. This will be useful in setting up plants to process slack coal into domestic fuel and may also eventually lead to a process for the production of formed coke for metallurgical purposes.

Synthesis of cresols and xylenols: Cresols and xylenols are required by a variety of industries and are being imported. Two routes, one based on *p*-toluenesulphonic acid and the other on alkylation of phenol, are being tried for the synthesis.

Mineral Products and Inorganic Chemicals

Active carbon from coconut shell: Studies on the preparation of activated carbon from coconut shell have been undertaken using different techniques, namely steam activation, chemical activation, and chemical activation followed by steam activation. Studies are in progress to find the most suitable method and conditions of activation.

Carbon black from rice husk: Carbon black worth nearly 2.5 crores is annually imported for use in rubber, plastic, printing ink and paint industries. The source material from which the carbon black is prepared considerably influences the end product; for example, denser materials yield carbons with high bulk density. The object of the study is to carbonize rice husk into a product low in ash, bulk density and oil adsorption and having medium surface area, low volatile matter and high fixed carbon content.

Other projects under investigation in this field relate to: standard and adsorbent earths; gamma-alumina; barium phosphate pigment; special grade sodium silicate; ammonia synthesis catalyst; cracking catalysts; and catalyst based on zinc oxide.

Industrial Ceramics

Glass-lining of chemical process equipment: Glass-lined equipment is vital for the chemical industry, but the country's requirements are almost entirely being imported. The laboratory has developed a process for making the frit and for using it in glass-lining. Pilot plant facilities for fritting the glasses and for firing the glass-lined vessels have been set up in collaboration with a local industry, and pilot plant work is in progress.

Calcined alumina: Pure calcined aluminas are not manufactured in India, and are extremely suitable for high strength and high voltage insulation and use in spark plug industry, in the manufacture of fused abrasives, and chemical and electronics industries. Development of calcined alumina for specific uses is envisaged.

Other projects in this field include PCE cones and thermoscopic bars.

Chemical Engineering

Cyanuric chloride: This is an important chemical used as an optical whitening agent in dyes and pigments. The objective of this project, sponsored by a private firm, is to try an improved reactor system and to generate data for the design of a commercial unit.

Other projects under study relate to: continuous chlorination for the production of benzotrichloride benzyl butyl phthalate; formic acid oxalic acid; glyoxal; computer oriented studies directed towar multi-stage optimization, design o heat exchangers and chemical plan and equipment, and on-line control of distillation columns and simulation.

Technical assistance is being provided to the Daurala Sugar Works, Daurala in the commissioning of their commercial plants for the production of benzyl group of chemicals.

Cellulose and speciality papers

Research programms in this area relate to the development of speciality papers, cellulose-based filter aids and filter papers.

Entomology

Studies in this field include insecticidal action, neurotoxins, insect control by biological methods and bioassay of chemical and plant products for insecticidal property.

Biochemistry

Studies are being carried out in the following areas: mechanisms controlling biochemical functions, nucleic acids, structure-function relationship in proteins, biochemistry of reproduction and metabolism of moulds and production of certain fine biochemicals required by the Biochemicals Unit of CSIR.

Techno-economic surveys

Surveys to collect economic and market intelligence data on the following chemicals are under way: benzyl chemicals, gamma-alumina, epichlorohydrin and colloidal graphite.

Second Conference on Water Desalination

The second Conference on Water Desalination was held from 1 to 3 March 1972 at the Central Salt & Marine Chemicals Research Institute (CSMCRI), Bhavnagar. Eighty delegates attended the conference, which was inaugurated by Prof. R. S. Mehta, Vice-Chancellor, Sardar Patel University, Vallabh Vidyanagar. Thirty-seven papers, including three special papers, were discussed at the conference organized as group discussion in four technical sessions devoted to: (1) Distillation processes; (2) Membrane processes of reverse osmosis and electro-dialysis; (3) Other processes including ion-exchange and freezing; and (4) General session on survey, economics, etc. Brief accounts of some of the papers follow:

Distillation Processes

The papers presented at this session fell under three categories: (i) LTV multiple effect distillation, (ii) multi-stage flash and vapour compression distillation, and (iii) general and fundamental studies.

LTV Multiple effect distillation

In his paper 'Process and cost analysis of 2.5 million gallons/day VTE plant: downflow and upflow', G. Coury, of the Distillation Division, Office of Saline Water, Washington, described both modes of operation. On the basis of cost comparisons it is shown that upflow system results in a 6% reduction in capital cost (and hence in lower water cost) in comparison to downflow for 2.5 million gallons/day (MGD) plant, and this improves as the plant size increases to 10 MGD.

Multi-stage flash and vapour compression distillation

R. Alward, P. K. Ghosh and S. Vossooghi, of Brace Research Institute, Canada, indicated in their paper that vapour compression distillation units could be operated with wind energy on the basis of results obtained in the runs in which wind energy was simulated using a variable energy input system.

General and fundamental studies

M. H. Mehta and coworkers, of CSMCRI, Bhavnagar, gave the experimental results on modified tube surfaces prepared by them, which showed gains in the heat transfer coefficients. Discussing the application of these tubes in actual desalination plants they gave some results obtained with a laboratory vapour compression unit coupled to a single tube heater fitted with a tube having spiral corrugations.

M. H. Mehta (CSMCRI, Bhavnagar) presented, in the absence of the author D. G. Thomas (Oak Ridge National Laboratory, USA), the special paper entitled 'Prospects for further improvement in enhanced heat transfer surfaces'. The paper outlined the progress made todate in the field of enhanced heat transfer surfaces and improvements which could be expected from such surfaces. It was concluded that the enhanced surfaces give overall heat transfer coefficients as high as 6000 Btu/hr ft^2 °F, but such high values will have little impact on desalination costs unless reliable procedures are developed for reducing the fouling factor to the lower limit of 0.00006-0.00008, sometimes observed in practice.

During discussions interest was shown in enhanced heat transfer surfaces. The cost of double fluted tubes, their fabrication and testing in the country were some of the points of interest. Though the difference in the cost of such tubes and plain tubes is quite considerable at present, it was pointed out that with technological developments this gap could be reduced. In the context of non-availability of cupro-nickel tubes in the country, Chinnappa (International Nickel Co) disclosed that these alloys would be made in the near future in the country. K. S. G. Doss (IIT, Madras) pointed out that more emphasis should be given to simple wire-wound tubes than other shapes and profiles, and that such tubes would be cheaper than fluted or roped tubes.

In conclusion, the chairman emphasized the need for more efforts to make desalted water cheaper for use in agriculture and for augmenting water supplies of metropolitan cities. He listed the following major areas in which research and development work requires to be extensively carried out: (i) prevention of scaling; (ii) use of enhanced surfaces and configurations for obtaining high heat transfer coefficients; and (iii) improvement in operational techniques.

Membrane Processes

The session was divided into two sub-sessions: Reverse osmosis; and Electrodialysis processes.

Two papers from CSMCRI scientists dealt with: (i) effect of different parameters on the preparation of cellulose acetate tubular osmotic membranes; and (ii) mass transfer characteristics of cellulose acetate membranes in the prediction of their performance. The first paper gave details of the membrane casting technique for tubular membranes and their performance in treating brackish water. In the other, the water permeability constant and solute transport parameter were shown to be a function of pressure. The product water flux, boundary layer cocentration and product water salinity were shown to be dependent on the feed flow rates and feed concentration. While the solute transport parameter was found to be independent of feed concentration and feed flow rates, the mass transfer coefficient was found to be a function of these two parameters.

In a critical review of some fundamental aspects of reverse osmosis, K. S. G. Doss put forward suggestions for improving the technique of membrane preparation. The membrane materials should have the groups known for inducing structure building in water; also, separate layers should be used for support and salt rejection.

One of the papers of this session revealed that the present state of the reverse osmosis technique in France is at the commercial stage and seawater could be desalinated to 200 ppm by a two-stage process. It emphasized the need for pretreatment of water for enhancing the life of membranes.

A paper from the workers of the Gujarat State Fertilizers Co. Ltd and CSMCRI dealt with the application of reverse osmosis for recovering water from fertilizer industry effluents. The aim of the study, besides recovery of water, was the prevention of pollution from the fertilizer industry. Recovery of water from ammonia plant effluent was a feasibility. Urea rejection by reverse osmosis process was comparatively low. The cost of production of desalted water was found to be Rs 3·42 per 1000 gal on 50 000 gpd pilot plant scale.

Two papers from CSMCRI presented at the session on electrodialysis were concerned with: (i) interpolymer ion-exchange membranes and their performance in electrodialysis units, and (ii) considerations in electrodialysis process and plant performance. The first paper outlined the development of interpolymer ion-exchange membranes and the capability of the process for producing tailor-made cation and anion exchange membranes with good electrochemical characteristics. In the process, a two-way control—one by chemical cross-linking and the other by percentage loading of interpolymer—on the dimensional characteristics of the membranes was discussed. Desalination studies conducted with saline water up to 10 000 ppm and also seawater to produce potable water were highly successful with high current efficiency and low power requirement. The second paper gave the relevance of membrane characteristics on electrodialysis process and plant performance. The performance of two membranes developed at CSMCRI, viz. heterogeneous membranes based on PVC and indigenous resins, and interpolymer membranes, were compared.

The last paper of the session on 'Performance of 5000 litres/day and 10 000 litres/day plants' from the Defence Laboratory, Jodhpur was presented by C. D. Dwivedi. The plant consists of 50 cell pairs of size 90 cm × 40 cm in 8 modules, each delivering 1250 litres/day of product water, and the average power consumption was 1 kWh for the removal of 1000 ppm tds from 1000 litres of water.

Freezing and Ion-exchange Processes

The first paper in this session dealt with the VFVC process by W. W. Rinne and W. F. Savage of the Office of Saline Water, Washington. The attractive feature of the process is the desalting of sea and brackish waters in areas where electrical power is the only source and where the water to be purified contains appreciable quantities of scale-forming salts.

The development of water filter candles, which can remove colloidal impurities and harmful bacteria in a single step at moderate cost, was outlined in a paper. The usefulness of these filters in pre-treatment steps before demineralization by reverse osmosis or ion-exchange techniques was indicated.

General

In his special lecture entitled 'Some socio-economic problems of water desalination in India', D. S. Datar reviewed the water supply situation in the country and desalination research being carried out in various organizations in the country. According to him the efforts made in the development of various desalination techniques have the scope for utilization in solving water supply problems in rural areas, in industries and to meet defence needs. With respect to urban water supply, nuclear power-cum-desalination plants will be suitable for Bombay and Madras, and a third such project is suggested for the Saurashtra region.

The utilization of saline water for agriculture was the subject of one of the papers of this session. Considering the high cost of desalted water for irrigation, N. T. Singh (Punjab Agricultural University, Ludhiana) suggested treatment of saline water with gypsum to ameliorate the water.

In the concluding session of the conference, D. J. Mehta (CSMCRI) mentioned that the Coordination Committee on Desalination constituted in 1967 did not prove to be very effective. He suggested the formation of a technical group on Desalination consisting of CSMCRI, BARC, Defence R & D (Engrs) in which working scientists should form the core.

SITRA's Eleventh Technological Conference

The eleventh Technological Conference, organized by the South India Textile Research Association (SITRA), Coimbatore, was held at Coimbatore on 9 April 1972. The conference was inaugurated by Dr Y. Nayudamma, Director General, Scientific and Industrial Research, who in his address drew attention to a statement by the Minister for Planning, Science and Technology that the centre-piece of the fifth Five-Year Plan would be the provision of basic minimum needs of the people within a time-bound schedule and provision of increasing employment and income opportunity over a wide front and that this would be sought to be accomplished in a manner which reduces regional disparities. In this context, Dr Nayudamma inquired of the role the textile industry would play in achieving this goal. Regarding machinery required for modernization, he called upon the engineering industry to take up the production of textile machinery which are imported at present. He suggested to the engineering industry that a Textile Machinery Research and Industrial Centre be set up for designing machinery suited to Indian textile industry. He also called upon the unemployed engineers to take up the manufacture of testing equipment, most of which are being imported. Referring to the role of CSIR, he said that if only the industry and SITRA come up with clear-cut specific projects of national importance and industrial relevance, CSIR would give careful consideration and fund such projects. The Director General also suggested that SITRA may work out concrete proposals in regard to: textile machinery manufacture, industrial design, textile process; instruments; and market intelligence and technological forecasting.

Seven papers dealing with the various aspects of textile technology were presented. A brief account of the papers presented follows.

The criteria for capital investment with special reference to textile industry were dealt with in a paper presented by Miss Indira Doraiswamy. By using the discounted cash flow method the first year savings, life of equipment, depreciation and salvage value of machines were considered, and the replacement costs and payback period were worked out.

Manufacture of ployester-cotton blended sarees on handlooms was the theme of the paper presented by K. S. Shankaranarayana. The sarees possess the desirable easy care and crease recovery properties as well as intricate hand-woven designs for which handloom sarees are popular. The problems faced in the printing of sarees were also dealt with in this paper.

The results of a CSIR-sponsored project on the 'open end spinning' were outlined in a paper. It has been possible to produce yarns superior to ring-spun yarns in evenness and regularity of strength and extension. Rotor speeds up to about 35 000 rpm have been achieved. A comparison of properties of open end and ring-spun yarns was also made.

The effect of atmospheric conditions during spinning on yarn properties and spinning efficiency was the subject of a paper. It has been found that least number of end breaks are produced during spinning at an atmospheric temperature of 70-77° F and 41-48% RH.

The results of studies on the effect of top roll pressure on end breaks and yarn quality were set out in one of the papers. Better evenness and considerable reduction in end breaks could be achieved by using softer cots and an optimum pressure on the rollers. The overall economics of using softer cots at the optimum pressure was also discussed.

A fundamental study on the taper and its relation to the physical properties of cotton fibres was the subject of a paper presented by K. N. Seshan. An attempt was made to define taper and to examine the relationship between the fibre end taper and the gross physical and fine structural properties of cotton.

Synthesis of Quartz Single Crystals

Widely used for making oscillators and filters required by the electronics industry, quartz single crystal is a material of strategic importance. At present, such crystals have to be entirely imported. Flawless quartz single crystals of suitable size and grade were synthesized by the Central Glass & Ceramic Research Institute (CGCRI), Calcutta in 1967 on a laboratory scale using the hydrothermal technique. In 1968, it was decided to set up a pilot plant for the production of the crystals. The transition from laboratory research to production was planned in three stages.

The first phase of work, or laboratory scale of work, for developing the hydrothermal technique, standardizing the process variables and improving the growth rate and quality of product by a suitable choice of solvents and dopants has yielded valuable data. A slow growth rate combined with the use of lithium nitrite as dopant in sodium carbonate solvent was found to improve the quality of crystals. Use of sodium carbonate as solvent minimizes the corrosion of the autoclaves. The second phase of work, or prototype research, entailing the development of process technology for batch production and designing of the basic unit having 5 ft long and 3 in. I.D. autoclaves prototype to the pilot plant was completed in 1971. The first batch of about 6 in. long, visually perfect crystals was obtained from the batch production unit in February 1972. The best *Q*-value of a single crystal so far obtained is 1.1×10^6. Some of the crystals are now under performance trial at the Bharat Electronics Ltd (BEL), Bangalore. The CGCRI pilot plant has been designed and is under installation. It has been proposed that the last phase of work, or production R & D in 5 ft long 3 in. I.D. autoclaves, be transferred to a semi-commercial unit to be set up at BEL, the actual users of the material, and that the institute's pilot plant be converted into a quality improvement unit.

Chemical Modification of Collagen by Graft Copolymerization with Vinyl Monomers

Graft copolymerization is widely used for synthesizing new forms of polymeric materials and for modifying the properties of natural and synthetic polymers. Collagen has been modified by graft copolymerization with different vinyl monomers using ceric ion initiation technique, for the first time, by Shri K. Panduranga Rao of the Central Leather Research Institute, Madras. The effect of initiator concentration, monomer concentration, time and temperature on the graft copolymerization of collagen with methyl methacrylate (MMA) was investigated. The number of grafting sites and the number-average molecular weights of grafted poly(MMA) branches obtained under different polymerization conditions indicate that the branch length and the number of reaction sites are considerably influenced by these factors. However, the percentage of grafting was mainly influenced by the initiator and monomer concentrations. The diffusion rate of the monomer was also found to be an important factor affecting the degree of grafting. For an unambiguous characterization of collagen-vinyl graft copolymers the grafted side chains were isolated and proof of grafting was provided by several methods. Electron microscopic observations of grafted collagen fibrils and ultrathin sections of fibrils did not show cross striations. These results indicate that the polymer has penetrated into the fibrils. Graft copolymerization of MMA on a number of modified collagens was studied to elucidate the mechanism of oxidation of collagen and to determine the grafting sites on collagen. The number of grafting sites obtained in the case of unmodified collagen indicates that the grafting reactions involved only a small proportion of fibre molecules. None of the modifications of the different functional groups of collagen could completely eliminate grafting. The general trend of the results obtained with modified collagen samples indicates that hydroxy groups and the peptide backbone may provide sites for initiation of grafting reaction.

Methods followed for the grafting of vinyl monomers on collagen powder and collagen solution were however found to be unsuitable for grafting on animal skins and leathers which have a three-dimensional network. In this case, an emulsion polymerization technique using suitable wetting agents and surfactant was found to give successful results. The results point to the conclusion that grafting, for instance, with poly(acrylonitrile), poly(methyl acrylate), poly(butyl acrylate) and poly (MMA) could be accomplished, combining the good qualities of both the synthetics and natural fibres. Grafted leathers were full and showed improved properties such as decreased water absorption, increased resistance to alkalis, acids and fungi, improved light fastness of dyed leathers, and improved gloss of the finished leathers without detracting from the favourable properties of leathers produced in the conventional way.

Shri Panduranga Rao was awarded the Ph.D. degree (1972) by the Madras University for his thesis entitled 'The preparation and determination of the physico-chemical properties of chemically modified collagen'.

CSIR SUPPORT TO RESEARCH

New Schemes

Theory of Concave Grating and its Mountings

A new CSIR research scheme under the purview of the Physical Research Committee has been sanctioned at the Department of Physics, Allahabad University, Allahabad. Dr M. M. Joshi (principal investigator) of the Department proposes to make experimental verification of the theoretical work done on the theory of concave grating and its mountings, specifically in the case of a new mounting of the concave grating and in the case of concave transmission grating.

Phenolic Constituents of Some Indian Plants

Under the purview of the Chemical Research Committee, a new CSIR research scheme has been granted to Dr W. Rahman (principal investigator) at the Department of Chemistry, Aligarh Muslim University, Aligarh. Studies envisaged in the research scheme include: an intensive and systematic survey of phenolic contents with special reference to biflavonyls of Gymnosperms available in the country; refinement in techniques of isolation of homogeneous components from plant extracts with special reference to the minor constituents; separation of isomeric mixtures; stereochemical studies including determination of absolute configuration by ORD, current density and X-ray studies; chemotaxonomy; physiological behaviour of constituents from natural sources and synthesis of compounds with modification in substituents as well as inter-flavonyl linkage with a view to studying the relationship between the structure and physiological behaviour; and biogenetic-type synthesis of biflavonyls.

Virus Diseases of Tobacco, Tomato and Brinjal

Tobacco, tomato and brinjal have been reported to be extremely susceptible to a large number of viruses. No systematic study has been made so far to isolate and identify these viruses, although they take a heavy toll of plant life. Flowering and fruiting in plants are also considerably reduced. In a new CSIR research scheme granted to him, Dr G. S. Verma (principal investigator) of the Botany Department, Lucknow University, Lucknow, proposes to: (i) investigate the viral diseases and their causes by studying the symptomatology, host range and mode of transmission of these viruses; (ii) study the environmental factors and cultural conditions affecting the disease severity; and (iii) carry out serological studies for the proper identification of viruses. Attempts will also be made to study the mode of spreading of the viruses in nature.

Studies on Indian Strains of Aspergilli with Special Reference to their Acid Producing Capacity

The genus *Aspergillus* is of considerable importance in the biosynthesis of organic acids. The importance of the genus is further enhanced by its pathogenic, allergenic and toxicological influences, especially on animals including human beings, and rarely on plants. Out of the 137 species and 26 varieties of the genus, only 54 species and 18 varieties have been reported in India. Information on the acid producing capacity of Indian strains of fungi is meagre. Under a new CSIR research scheme sanctioned at the Department of Botany of the Lucknow University, Dr J. N. Puri (principal investigator) proposes to study: (1) occurrence and distribution of various species of the genus as related to various climatic and habitat features; and (2) the organic acid production capacity of various species, varieties and strains, and characterization and isolation of acids.

Synthetic and Structural Studies on Metal Derivatives of Amidoximes and Hydroxamic Acid

Metal derivatives of amidoximes and hydroxamic acids have not received much attention except from the point of view of their analytical applications. Under a new CSIR research scheme granted to Dr V. D. Gupta (principal investigator) of the Department of Chemistry, Rajasthan University, Jaipur, it is proposed to synthesize derivatives of amidoximes and hydroxamic acids with the elements of III, IV and V groups. The molecular weight and conductivity of the derivatives will be determined to elucidate the nature of the unit species. Infrared, electronic, nuclear magnetic resonance and Mössbauer spectra of the derivatives will also be analysed to infer the mode of attachment of the ligand to metal, stereochemical arrangement of the ligand and coordination number of the Central metal atom. It is also envisaged to undertake thermal studies of these derivatives with a view to investigating the effect of various factors like the nature of metal, ligand and its substituents on the stability of the product.

Completed Schemes

Some Methods and Problems in Graph Enumeration Theory

Though graph enumeration theory has found applications in a variety of fields like electrical network theory, statistical mechanics, and sociology, the theoretical development of the subject needs more attention. Investigations on some methods and problems in graph enumeration theory made by Shri M. R. Sridharan, a CSIR fellow, who worked under the guidance of Dr K. R. Parthasarathy, at the Department of Mathematics, Indian Institute of Technology, Madras, have led to some important theoretical results and solutions to some outstanding graph enumeration problems.

The concept of a U-polynomial as propounded by de Bruijn has been extended to a W-polynomial leading to a weighted structure theorem, and Harary and Palmer's power group enumeration theorems have been derived as corollaries. Enumeration of self-complementary and self-converse oriented graphs and isographs of different varieties is also reported.

Weight functions earlier mentioned in literature have been modified to obtain generating functions for self-complementary graphs and digraphs in terms of partitions. Solutions have been found for the enumeration of self-complementary and self-converse oriented graphs. An algorithm for the enumeration of pseudo-symmetric graphs and oriented graphs is presented, which in turn leads to Eulerian digraphs. This algorithm is a new approach to the solutions of graph enumeration problems. The algorithm is modified to enumerate k-regular graphs and Euler graphs in terms of the number of lines and homeomorphically irreducible graphs.

Shri Sridharan was awarded the Ph.D. degree (1971) of the Indian Institute of Technology, Madras for his thesis relating to the work.

PATENTS ACCEPTED

Indian Pat. 125357

Cheap water filters
H. Bora, B. K. Lonsane, S. P. Srivastava, A. C. Khazanchi & M. S. Iyengar
RRL, Jorhat

The process covered by the patent describes the manufacture of water filter candles and their outfits for getting bacteria-free potable water from any water supply. Special features of the process are the use of entirely indigenous raw materials and low production cost. Imported candles cost nearly Rs 40-50 per piece, whereas candles prepared according to the patented process would cost only Rs 4 per piece.

Process. A workable slurry is prepared by mixing a suitable grade of powdered clays/burnt clays/ash from agricultural wastes, a binder clay and a colloidal solution of silver or its salts. Candles are prepared in specially designed moulds, and after drying are fired at 1000-1200°C in a furnace. Fired candles are sand-papered and fitted with an outlet nipple.

These candles can be fitted in double chambered vessels or flasks. When water percolates through the porous candles, colloidal, suspended and bacterial impurities are eliminated. These candles are self-sterilizing, and could be used for more than a year. Laboratory tests indicate that the candles can purify raw water containing up to 2 million bacteria per millilitre to zero bacterial count.

Indian Pat. 126391

A process for manufacture of tartaric acid
B. K. Saikia, R. C. Das & M. S. Iyengar
RRL, Jorhat

The conventional raw material for the manufacture of tartaric acid is a byproduct from wine industry. This source cannot be utilized in India as wine wastes are not indigenously available. An alternative source for the production of tartaric acid is tamarind leaves which are easily available in the country.

The process covered by the patent consists in digesting the tamarind leaves in a pressure vessel under suitable conditions. The mother liquor is decolorized with activated charcoal and fullers earth, and the decolorized filtrate so obtainned is concentrated under vacuum. Finally, the concentrated liquid is crystallized for getting crystals of tartaric acid (purity 97·5%). All the equipment required for the production of tartaric acid can be fabricated in the country. The cost of production of tartaric acid has been estimated at Rs 13.90/kg in a plant capable of producing 10 tonnes/annum of tartaric acid.

Indian Pat. 126988

A process for the recovery of silver and cellulosic bases from waste films
M. S. Iyengar, J. L. Ghose, R. K. Chakrabarti & R. Haque
RRL, Jorhat

Large quantities of developed films, which are usually discarded, may be efficiently utilized for the recovery of silver and cellulose base material for reuse. Silver may be used as such or in making photographic chemicals, and the cellulose base material may be used as such.

The invention relates to the development of a process for the recovery of silver and cellulosic bases from waste films. In this process the waste film is dipped in boiling water maintained at a specific pH; and the emulsion of silver in gelatin is released, leaving the cellulose base material intact. The mass containing silver and gelatin is dried and melted with flux. The impurities form a gangue with the flux and silver is recovered as a shining mass. The cellulosic base may be reused after drying. Similarly, silver may be recovered from used developer solutions.

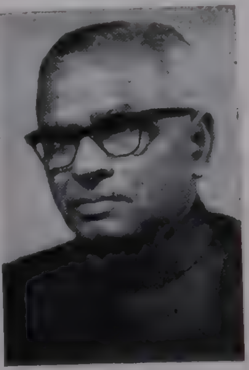
Structural Engineers Easy Language

Brought out by the computer centre of the Structural Engineering Research Centre, Roorkee, Structural Engineers Easy Language (STEEL) is a problem-oriented language for use on an IBM 1620 computer and is designed to help structural designers to carry out linear elastic analysis of framed structures such as multistoreyed buildings, transmission line towers, roof grids, bridge grids, trusses, arches and many other structures. STEEL is a compact programming system for the solution of structural engineering problems on a digital computer. It consists of: (i) a programming language that describes the problem, and (ii) a processor (computer programme) that accepts this language and produces the desired results. This reference manual on STEEL describes the language and explains its use. The language has the advantage that communication with the computer, through STEEL, is entirely in the engineer's language.

Structural engineers using this system need have no knowledge of computer programming. It is expected that in one thorough reading of the reference manual (93+vii pages, demy 4 to) one can easily programme one's problem in STEEL with success.

Shri A. Krishnamurthi

Shri A. Krishnamurthi, Chief Editor, Publications & Information Directorate, New Delhi, proceeded on leave from 12 June 1972 preparatory to retirement (9 October 1972).



Shri Krishnamurthi (*b.* 10 October 1912) had his early education at the Mysore University. After passing his M.Sc. in organic chemistry from the Banaras Hindu University in 1935, he joined the Department of Biochemistry, Indian Institute of Science, Bangalore as a research scholar and continued there till 1942. After a few years' experience in industry, Shri Krishnamurthi joined, in 1944, the Chemical Laboratories, CSIR, New Delhi. His association with the CSIR's premier journal, the *Journal of Scientific & Industrial Research* (JSIR), dates back to 1946. It is largely due to his endeavour that JSIR, started as a quarterly in 1942, has made phenomenal progress, especially during the last 10 years. Under his able stewardship, various sections of the journal have emerged as independent subject periodicals—Indian Journal of Chemistry, Indian Journal of Technology, Indian Journal of Pure & Applied Physics, Indian Journal of Experimental Biology and Indian Journal of Biochemistry and Biophysics. The national and international standing attained by these journals is primarily due to the untiring efforts of Shri Krishnamurthi. Two more journals, the Indian Journal of Radio and Space Physics (quarterly) and the Indian Journal of Marine Sciences (bi-annual) have been added to this family from 1972.

During Shri Krishnamurthi's tenure as Chief Editor (1967-72), Vol. VIII of the Wealth of India: Raw Materials and Part VII of the Wealth of India: Industrial Products were brought out. He was also largely responsible for implementing the proposal regarding the translation of the Wealth of India into Hindi. Volume I of the Hindi version (titled *Bharat ki Sampada*) was released in 1971. At the time of his retirement, Vols II and III of *Bharat ki Sampada* and Vol. IX of the Wealth of India: Raw Materials were in the final stages of printing.

Under his overall guidance and scrutiny were brought out several botanical and zoological monographs—Cedrus, Proteaceae, Pinus, Indian Thysanoptera, and The Millipede-Thyropygus, to mention a few. Also stand to Shri Krishnamurthi's credit numerous other publications like the CSIR Annual Reports, CSIR News and CSIR Handbooks for improving the scope and presentation of the contents of which he spared no efforts.

Shri Y. R. Chadha

Shri Y. R. Chadha, Scientist, Publications & Information Directorate, New Delhi, took over as officiating Chief Editor from Shri A. Krishnamurthi, with effect from 12 June 1972.

PATENTS FILED

47-020677: Japan (corresponding to Indian Pat. 130199): A new intravaginal contraceptive device (IVCD), P. Dasgupta, N. M. Khanna, A. B. Kar & M. L. Dhar—CDRI, Lucknow.

134557: A method of strengthening of soil, D. Mohan, A. G. Dastidar, G. S. Jain, D. Sharma & M.P. Jain—CBRI, Roorkee.

134850: A method of manufacture for forming integral fins on metal tubes, A. K. De, G. Doraiswamy, D. Bhattacharyya & A. Hajra—CMERI, Durgapur.

134919: A strain gauge breathing transducer, V. R. Singh & Ram Parshad—NPL, New Delhi.

134963: A method of preparing a photoemulsion suitable for printed circuits, Surinder Singh—NPL, New Delhi.

134978: A strain gauge blood pressure transducer, V. R. Singh & Ram Parshad—NPL, New Delhi.

135028: An improved rocker for processing leathers, T. Ramanathan —CLRI, Madras.

135030: Improvements in or relating to prevention of tarnishing of copper and copper base alloys, A. N. Mukherjee, S. R. Addanki & A. K. Lahiri—NML, Jamshedpur.

135066: A strain gauge obstruction flow transducer, V. R. Singh & Ram Parshad—NPL, New Delhi.

135077: Improvements in or relating to obtaining pharmacologically active anti-inflammatory agents from curcumin, N. Ghatak, N. Basu & R. B. Arora—CSIR, New Delhi.

SHANTI SWARUP BHATNAGAR AWARDS FOR SCIENCE AND TECHNOLOGY-1971

The Council of Scientific & Industrial Research offers every year Shanti Swarup Bhatnagar Awards of Rs 10 000 each in the following fields: (1) Physical Sciences, (2) Chemical Sciences, (3) Biological Sciences, (4) Engineering Sciences, (5) Medical Sciences, (6) Mathematical Sciences, and (7) Other Sciences.

The award shall be made on the basis of conspicuously important contributions during the 5 years preceding the prize year, viz. 1966 to 1970. The award is confined to scientists/technologists/engineers of Indian citizenship below 45 years of age as on 31 December 1971.

Nominations for the award are sent not by individuals but by scientific societies of all-India character, university faculties and postgraduate councils who would forward to CSIR a statement on the work and attainments of each nominee, a biographical sketch along with details, lists and reprints of published work.

Printed rules and regulations and the proforma for submitting nominations would be made available on request by Secretary, Council of Scientific & Industrial Research, Rafi Marg, New Delhi 1.

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CSIR NEWS

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27 JUL 1972

SEMINAR ON ELECTROCHEMISTRY

The twelfth seminar on Electrochemistry was held from 25 to 27 March 1972 at the Central Electrochemical Research Institute (CECRI), Karaikudi. An annual feature of the activities of the institute, the seminar was inaugurated this year by Shri C. Subramaniam, Minister for Planning, Science & Technology, and Vice-President, CSIR.

Thirty-five papers were presented in the following seven technical sessions: (1) Electro-organic and electro-inorganic products; (2) Electrothermics and electrometallurgy; (3) Electrode kinetics, electrochemical equilibria and electroanalysis; (4) Corrosion; (5) Solid state electrochemistry; (6) Electrodeposition and metal finishing; and (7) Batteries. Brief accounts of the papers presented in the various sessions follow:

Electro-organic and Electro-inorganic Products

A two-stage process for the electrolytic oxidation of ethylbenzene to acetophenone was described in one of the papers from CECRI. An interesting observation was that the methyl group is not oxidized.

S. Balagopal (CECRI) presented a paper on 'Reduction potential of alkaline solution of dialdehyde starch'. Based on the reducing power of alkaline dialdehyde starch solution, a few vat dyes were reduced by dialdehyde starch in the dyeing of textile fabrics.

Electrothermics and Electrometallurgy

The feasibility of electrolytic recovery of gallium from commercial Bayer liquor of Indian origin with a current efficiency of about 4% and yield of 90% under optimum conditions was reported in the paper presented by R. Srinivasan and coworkers (CECRI).

The beneficial effects of carbon black as a reducing agent and compounding agent in the production of titanium carbide from beneficiated ilmenite containing more than 75% titanium dioxide were reported by V. Aravamuthan and M. Sundaram (CECRI). It has been found that there is no specific advantage in using a costlier high purity commercial titanium dioxide in the production of titanium carbide in place of beneficiated ilmenite containing 75-80% titanium dioxide, as the iron carbide formed from the beneficiated ilmenite is easily eliminated by leaching with hydrochloric acid. Utilization of effluents in the chemical beneficiation of ilmenite was the subject of another paper presented by these two workers. They reported that anhydrous manganese chloride in admixtures with sodium and potassium chlorides can be produced in the molten state from manganese chloride solutions, and that the melt can be employed for the production of manganese alloys and also in electroplating steel articles with manganese metal, especially in the form of alloys.

Electrode Kinetics, Electrochemical Equilibria and Electroanalysis

The paper entitled 'Anodic behaviour of copper in alkali', by S.V. Burangey and N. A. Hampson of the Department of Chemistry, University of Longhborough, UK, brought out that the passivation of smooth copper electrodes in potassium hydroxide is rate-controlled by the diffusion of hydroxyl ions in the anode film. The authors explained the mechanism of the electrode reaction in terms of a semiconducting film developing at the electrode surface.

Corrosion

Thirteen papers were presented at this session. Anodic passivation characteristics of some structural materials (347SS, 430SS, 446SS, Inconel 600 and Kroll Zr) in nitric acid solutions containing fluorides was presented by N. S. D. Elayathu and coworkers (BARC, Bombay). The authors studied the complex passivation behaviour due to the influence of fluoride ion. The investigations reveal that a study of the anodic polarization characteristics of these alloys could be used to assess their service performance in nitric acid solutions containing fluorides. Anodic protection is found to be promising in most of the cases.

The corrosion of zinc and its inhibition in solutions of trichloracetic acid was dealt with in one of the papers presented at this session. The extent of corrosion was found to increase with increase in the concentration of the acid and the period of immersion. Almost complete (>99%) protection was reported to have been achieved with 0·5% concentrations of chromates and dichromates of sodium or potassium.

Reporting the performance of 36 protective schemes at Mandapam Camp, K. S. Rajagopalan and coworkers (CECRI) concluded that the best results are obtained with epoxy zinc chromate primer and epoxy coal tar finishing paints.

The results of studies on the effect of inhibitors on the extent of hydrogen permeation into steel in phosphoric acid solutions, both from the point of view of pickling and phosphate coating formation, were presented by N. Subramanyan and coworkers (CECRI). Formaldehyde, hexamine and dimethylaniline were found to suppress the hydrogen permeation into steel in phosphoric acid but not in phosphating solutions. Addition of thiourea slightly increases the hydrogen permeation both in phosphoric acid and phosphate solutions. All these compounds inhibit corrosion of steel in phosphoric acid but only hexamine and thiourea inhibit corrosion in phosphating solution at room temperature. The addition of formaldehyde and dimethylaniline to phosphating bath does not affect the rate of coating formation, whereas thiourea completely suppresses it. The addition of hexamine almost doubles the rate of phosphate coating formation.

Solid State Electrochemistry

Four papers were presented at this session. The photovoltage exhibited by p-n heterojunction formed by the chemical deposition of p-type thallous sulphide on n-type silicon slice was reported by K. Nagaraja Rao and coworkers (CECRI). The importance of this system lies in the band gaps of thallous sulphide and silicon being almost the same.

Three other papers presented at this session related to: (i) photoluminescence of zinc silicate green phosphor; (ii) effect of sodium chloride and zinc sulphate as fluxes on photoluminescence of copper-activated zinc sulphide; and (iii) criterion for selecting zinc oxide material for electrophotographic coatings.

Electrodeposition and Metal Finishing

Commercial silver containing 6-7% copper can be refined to a high standard of purity, limiting copper and iron to 15 ppm in a single operation using a slightly modified Moebus cell with silver nitrate as electrolyte and stainless steel (316) plates as cathodes. The silver thus produced could be used in the manufacture of photographic grade silver nitrate. This was revealed by the workers of the Hindustan Photo Films Mfg Co. Ltd, Ootacamund in their paper.

Other papers presented at this session were concerned with: (i) effect of impurities on dentritic and related growth forms during electrodeposition; and (ii) properties of electroplated metals from ultrasonically agitated solutions.

Batteries

In the field of air depolarized cells, a new design of a metal reinforced hollow cylindrical porous carbon element was reported from CECRI. An air depolarized cell in which this porous carbon electrode is used as cathode, zinc as anode, and sodium hydroxide as electrolyte gives an open circuit voltage of 1.4-1.45 V operating at 1.10-1.20 V, giving practically constant voltage throughout the life of the cell when used at normal current drains.

The performance characteristics of magnesium-*m*-dinitrobenzene cell developed at CECRI were dealt with by P.B. Mathur, R. Balasubramanian and N. Muniyandi. High energy density per unit weight and almost constant voltage performance over 80% of its capacity at various current drains are the salient features of this cell, which is likely to find special applications where constant voltage discharge at medium and high rates and high power output weight are desired.

Other papers dealt with: (i) role of spatial dependence of recombination centres in semiconductor photoelectric devices; (ii) cold set dry cells; and (iii) performance characteristics of magnesium-lead chloride battery system.

PROGRESS REPORTS

CRRI Annual Report : 1970-71

Development of appropriate serviceability rating indices for rigid and flexible pavements, photo interpretation techniques for the location of hidden road construction materials, strengthening of bridges by post-tensioning, and traffic and transportation studies in Greater Delhi are some of the highlights of work of the Central Road Research Institute (CRRI), New Delhi, according to its annual report for 1970-71 published recently. The 116-page report records the progress of work under the following main subdisciplines: Soils; Flexible pavements; Rigid pavements, Roads; Traffic engineering, economics and statistics; Extension; and Bridges.

Continuing its role as consultant to various highway engineering organizations in general and the Border Roads Organization in particular the institute undertook the following landslide problems for investigation and analysis: (i) landslide susceptibility of Singtam-Rangpo Road, N.H. 31-A, Sikkim; (ii) landslide susceptibility of Kohima-Meluri Road, Nagaland; (iii) landslide along the Rishikesh-Joshimath Road (Alaknanda tragedy); and (iv) landslide susceptibility and choice of alignment of Kohima-Piphima Road N.H. 39, Nagaland.

An important project concerned with flexible pavements under investigation relates to the working out of equivalent thicknesses based on the actual performance of bituminous and non-bituminous base courses. A test track was constructed on Delhi-Mathura Road N.H. 2 in front of the institute in April-June 1970. Various specifications were laid after removing the existing black top and levelling the WBM to the required extent. The bituminous base courses included pre-mix macadam, penetration macadam (full grout) and built-up spray grout. Both plastic and non-plastic fillers were used in WBM sections. There were 35 sections covering a total length of 1624 m. Measurements of surface unevenness were made before and after opening to traffic. Consolidation gauges were also installed under the wheel path to the full depth of the base course laid and Benkelman beam tests carried out at periodic intervals to record the deflection at the bottom of the base course as well as on the black top. Photographic records and visual observations are being made at regular intervals to study the behaviour of various sections for a comparative evaluation.

Investigations on the use of dolomitic limes for making lime-burnt clay puzzolana were continued. Compressive strength tests were conducted on 3·81 cm cubes of 1:2:9 lime-burnt clay puzzolana-sand mortar made from dolomitic limes containing heavy magnesium oxide from 0 to 30% after 7, 28, 90 and 180 days of curing at two curing temperatures, 30±2°C and 60°C. The results indicate that the maximum increase in compressive strength for all ages is obtained with 5% replacement of lime by heavy magnesium oxide and the maximum content of magnesium oxide that can be tolerated without reduction in strength would be about 15%. Samples cured at 60°C show higher rate of strength development during the first few days than those cured at 30±2°C. Compressive strength tests conducted on cubes (3·81 cm) of 1:2:9 lime-burnt clay puzzolana-sand mortar made from laboratory-prepared dolomitic limes containing a total of 30% of light and heavy magnesium oxide in different proportions after 7, 28, 90 and 180 days of curing at 30±2°C and 60°C showed similar trends as in the case of samples with similar percentages of heavy magnesium oxide.

The construction of a 122 m × 15·24 m experimental prestressed concrete section consisting of 4 slabs, 122 m × 3·81 m × 15 cm, on an airfield taxi-track was completed during the year. The performance of the taxi-track has been satisfactory under traffic comprising aircraft having L.C.N. between 10 and 40.

Studies on the development of appropriate serviceability rating indices for rigid and flexible pavements were completed in two more zones, viz. southern zone (Andhra Pradesh) and northern zone (Uttar Pradesh), in collaboration with the respective State Public Works Department. The data obtained so far show that serviceability expectancy levels of road users varies from zone to zone.

The air-photo interpretation technique was extended to the location of hidden gravel deposits in an area of about 768 km² around Chandigarh. The findings confirmed the pattern already developed in USA.

Under the extension service of the institute, many new roads were constructed in Gujarat and Himachal Pradesh using the technique of soil-gravel stabilization.

Some of the important projects of consultancy work, besides landslide analysis, undertaken by CRRI relate to: improvement and strengthening of roads in different states; construction of a marine drive from Konark to Puri; road development in various states; and comprehensive traffic and transportation planning studies in Greater Bangalore and Greater Delhi.

NAL Annual Report : 1970-71

The annual report of the National Aeronautical Laboratory (NAL), Bangalore, published recently, records the progress of its research activities discipline-wise under: Aerodynamics; Propulsion; Structural Sciences; Material Sciences; Electronics; Instrumentation; and Mathematical Sciences. Seventy-one projects in all were investigated during the period which marks the beginning of the second decade of the laboratory's functioning. Against a total expenditure of Rs 10.56 million (Rs 5.04 million towards capital and Rs 5.53 million towards recurring expenditure) the income of the laboratory during the period amounted to Rs 1.6 million, the 4-ft trisonic tunnel facility accounting for the bulk of the revenues. This tunnel, the laboratory's major facility in aeronautics, was fully utilized, and as many as 900 test runs were carried out. As part of the satellite launching programme of the Indian Space Research Organization, the laboratory undertook the testing of models of multistage rockets for the satellite in the 4-ft tunnel. So far, 136 tests have been made on these models in the Mach number range 0.5-4.0. Two models of RH-100 rocket were also tested in the 4-ft tunnel. Tests on rocket pod models of varying configurations were also carried out in the Mach number range 0.8-1.7 on behalf of defence establishments.

The propulsion division concentrated its efforts on establishing facilities for undertaking component research in turbomachinery and jet propulsion. Work on the setting up of combustion and gasdynamics facilities made considerable progress. A heat exchanger was installed to obtain a continuous source of 10 lb/sec of unvitiated hot air up to a temperature of 600°K. Necessary instrumentation and control panels are being built to enable the operation of the test rigs remotely from the noise-proof control room. A test rig for catalytic ignition studies was built, erected and made ready. Development of a fluidic oscillator, suitable for measurement of high temperatures in gas stresses, was taken up. Tested up to 900°K for performance, the oscillator was found to give satisfactory performance with respect to pressure insensitivity, signal-to-noise ratio, reproducibility and accuracy in temperature measurements.

A test set-up for evaluating the performance of gas bearings was commissioned. Tests were carried out up to 6000 rpm at increasing supply pressures to determine the load carrying capacities and stiffness characteristics at various pressures and eccentricities. A computer-oriented technique for rapid critical speed calculation of turbomachinery rotor systems was developed for designing compressor and turbine research rigs.

In the field of structural sciences, the laboratory's activities were mainly in the following areas: vibration, flutter, application of matrix methods for structural analysis, optimization of structures, photoelasticity, fatigue, shell structures and design and development of composite structures. A fighter aircraft wing was tested for vibration characteristics using the multipoint ground resonance testing apparatus. A 1/10th scale model of a typical subsonic jet trainer aircraft wing was designed, fabricated and tested in the low speed wind tunnel for flutter characteristics. The results were correlated to full scale aircrafts. A preliminary programme in FORTRAN for optimizing structures by the stepwise gradient approach with flutter as a dynamic constraint was developed. It was used for solving flutter problem of sandwich panels employing finite element approach and for minimizing the total mass with a fixed flutter Mach number.

A project on full scale fatigue testing of a fighter aircraft was undertaken. The fullscale test facility, which can be loaded up to 240 tonnes under fatigue, was designed and is being set up. The 10-tonne random noise fatigue testing machine, developed by the laboratory, was commissioned. The machine is capable of applying any quasi-stationary random load history defined by eight rms levels, programmed on a punched tape, simulating non-stationary random load histories that may occur in service. The power spectrum of the load history can be shaped by varying the frequency response characteristics of the machine.

The materials science division continued work on composites, specially fibreglass reinforced plastics (FRP) materials, high temperature materials, material testing, and modern techniques for the fabrication and processing of materials. A variety of FRP components was developed and fabricated in order to gain a better understanding of the properties of FRP materials and to develop the FRP technology in the country for various industrial applications. Aerial masts and antennae insulators for high voltage circuit breaker were developed. Special mention may be made of the process developed for the fabrication of 3 cm radar reflector with 1 m diam, using FRP materials.

At the instance of Bharat Electronics Ltd, Bangalore, a feasibility study for the design and development of 6 m diam fibreglass radomes for protecting the antenna system of cyclone warning radar was undertaken. Based on the results, three radomes are being fabricated for supply to BEL at a cost of Rs 1 50 000 each; an imported 7 m diam radome costs about Rs 2 88 000.

A special purpose spark erosion machine for grooving of steel rolls was designed and fabricated using indigenous components and circuits developed in the laboratory, under a project sponsored by the Tata Iron & Steel Co., Jamshedpur.

An important achievement in the field of electronics was the development of a 12-digit electronic desk calculator. The calculator uses exclusively integrated circuits both of transistor-transistor logic (TTL) and metal oxide semiconductor (MOS) types, and has both fixed and floating mode arithmetic. A 3-digit digital plotter with 0.1% accuracy and a maximum speed of 60 plots/min was developed and fabricated. The plotter accepts data from FERRANTI-SIRIUS computer compatible 5-hole paper tape, punched card, and keyboard.

The laboratory has designed and developed an electronic load measuring system, using indigenous components, for the rotary wagon tipper on behalf of Heavy Machine Building Plant of the Heavy Engineering Corporation. The system costs Rs 9800 whereas an imported one costs about Rs 20 000.

Some of the significant achievements in the field of instrumentation relate to the development of a constant temperature hot film anemometer for the measurement of airflow; a piezoelectric type accelerometer (range 0-50 g; sensitivity 2 mV/g) and the associated high input impedance charge amplifier; a 2-channel FM telemetering system employing sub-carrier frequencies of 1 kHz and 10 kHz for the measurement of torque from rotating machineries; and an active filter using integrated circuits tunable to discrete frequencies for the range 1 Hz to 10 kHz with facility to operate as a low-pass, high-pass or band-pass filter.

In mathematical sciences, the laboratory's work was concerned with the development of computer programmes on SIRIUS for (i) associated legendre polynomial, (ii) analysis of variance and multi-regression analysis, and (iii) periodogram and spectral density analysis. A report on the feasibility of setting up a regional computer centre at Bangalore was prepared.

Ninety transducer devices and 85 measuring equipment worth Rs 2.25 lakhs were produced on the pilot plant. Multi-channel data systems, regulated power supplies, temperature controllers and magnetizer unit worth Rs 3.55 lakhs in all were also produced on the pilot plant.

The laboratory published 8 technical notes and 13 papers during the period.

CSIR SUPPORT TO RESEARCH

Completed Schemes

Interaction Relation for Reinforced Concrete Prismatic Members under Combined Bending and Torsion and under Combined Shear and Torsion

A theoretical study of the strength of reinforced concrete beams under combined bending and torsion followed by an experimental investigation has been made under a CSIR research scheme by Shri Y. Ananthanarayana (principal investigator) and Shri S. C. Natesan (co-principal investigator) at the P.S.G. College of Technology, Coimbatore during the period August 1969 to June 1971.

A detailed survey of all the available theories on combined bending and torsion has shown that the principal difference among them arises in the predominant torsion range, including pure torsional case.

A new theory of flexure-torque resistance has been developed as a result of the present investigation and this is capable of explaining most of the observed behaviour reported, in addition to providing the required continuity. The theory incorporates a longitudinal hinge mode as a valid mode of failure in beams without web steel and in beams with very light web steel relative to the amount of longitudinal steel.

The proposed theory incorporates for the first time some measure of compatibility requirements on steel strain and is free from empirical content. It is capable of providing highly reliable results in the predominant torsional range.

It has been found that beams provided with unequal reinforcement at the top and at the bottom and under-reinforced with regard to longitudinal steel (relative to web steel) result in an increase in the torsional strength with the addition of bending moment. When the beam is under-reinforced with regard to web steel, there is no increase in the torsional strength. In such cases, torsional strength tends to remain constant over a substantial part of the predominant torsional range.

The assumption made by several earlier investigators that both the categories of steel yield at failure is valid only under special cases and therefore is not admissible in a general analysis.

The second part of the study was concerned with the behaviour of reinforced concrete beams under combined shear and torsion. A detailed survey of all the available theories in regard to combined shear and torsion indicates that the principal difference among the theories arises throughout the complete shear-torsion range. Most of theories proposed are for the beams failing by the yielding of longitudinal steel or web steel, or both. Little information is available on the behaviour and strength of reinforced concrete beams failing by primary crushing of concrete. The simple addition of flexural shear stresses to torsional shear stresses, as ordinarily computed, yields unsatisfactory results in combination with a constant allowable shear stress. There appears to be a transition zone within which the total stresses developed increase with the increasing ratio of applied torque to applied shear.

The root-square-sum of torsional and flexural shear stresses may form a better design criterion than the numerical sum of shear stresses. Pure torsional strengths calculated using the formula given by ACI Committee 438 agree fairly with the test results of this investigation. The shear strengths computed by the ACI code are greater than the observed values and hence the ACI code formula needs revision in the case of beams failing by crushing mode. Shear capacity gets reduced due to the presence of torque and vice versa even at small eccentricities.

The theories proposed by Lessig, Yudin and Collins predict nonconservative strength values for the beams studied.

An empirical interaction diagram has been suggested to give a lower bound to the strength of beams under combined shear and torsion.

The Australian code recommendations form the safe lower bound to the test results.

Shri Ananthanarayana was awarded Ph.D. degree by the Madras University for his thesis relating to the studies on the strength of reinforced concrete beams under combined bending and torsion.

Determination of Atmospheric Turbidity Parameters from Pyrheliometric Measurements in India

Turbidity parameters provide an idea of the optical clarity of the atmosphere. Evaluation of these parameters is expected to help in the analysis of the instantaneous composition of the atmosphere, thus opening up the possibility for a synoptic and climatic survey of atmospheric aerosols. With this end in view, studies have been carried out by Shri Murari Lal, a CSIR research fellow, who worked under the guidance of Dr K. R. Saha, at the Department of Biophysics, Banaras Hindu University, Varanasi (Nov. 1968 to Oct. 1971).

The sample data consisting of more than 20 000 intensity values of the direct solar radiation for the entire spectrum as well as for the specified spectral bands separated by Schott glass filters were used for evaluating the turbidity parameters at all the twelve pyrheliometric stations in India employing Angstrom's techniques. An attempt has also been made to evaluate the estimates of natural illumination of direct solar radiation using the turbidity values.

It has been observed that, for the most part of the year, the wavelength exponent α is considerably smaller in the Indian subcontinent than that over the middle latitudes. During the hot summer months it approaches zero and is sometimes negative, indicating that the haze extinction is nearly neutral and independent of wavelength. The exponent α has a value close to unity during the winter months. It has also been observed that negative values of α are mostly associated with various optical phenomena around sun's disc and the presence of tenuous cirrus clouds in the upper troposphere.

The turbidity values were found to show large seasonal variations which are closely related to the origin of airmasses prevailing in the Indian atmosphere. The tropical continental airmass is usually two to three times more turbid than the modified continental polar airmass. It has also been observed that the turbidity is highly affected by the moisture content of the atmosphere. The turbidity values are generally uniform at all the coastal stations in winter months. During summer, the maritime aerosols originating from sea spray give rise to high turbidity values at these stations. The frequent occurrence of night-time inversions in winter months leads to high turbidity during early morning hours. In summer, the turbidity maximum is observed during the afternoon hours at all the stations considered in the study. A sharp fall in the turbidity is observed after thundershowers and with the onset of monsoon. Although the turbidity decreases at high level stations, it attains a high value at hill stations in India as a result of convective turbulence caused by local 'anabatic' winds.

The daylight illumination has been found to be maximum during the forenoon hours and minimum during the evening hours. No large seasonal variation in illumination flux is observed over the peninsular India whereas in North India, the illumination flux is maximum during summer months. The variations of illumination fluxes between low level and high level stations have also been discussed.

A thesis embodying the results of the study was submitted to the Banaras Hindu University for the award of Ph.D. degree.

New Schemes

Glyceride Composition of Some Indian Seed Oils

The triglyceride compositions of natural fats and oils have been studied by different methods such as fractional crystallization, countercurrent distribution, oxidation techniques and gas-liquid chromatography. The GLC technique has brought in a very high degree of quantitativeness in the elucidation of the glyceride compositions of fats and oils in two different ways—first, by virtue of its superiority in the analysis of the constituent fatty acids, and secondly, by its ability to separate and estimate directly the glycerides themselves. This direct separation of the glycerides according to their carbon number by GLC could be effectively combined with other chromatographic methods of glyceride separation such as reverse phase paper chromatography, partition column chromatography and $AgNO_3$ treated thin layer absorption chromatography. Another important approach to this problem is the determination of fatty acid composition, overall and at the 2nd position, by lipase hydrolysis of glycerides and subsequent analysis of the mixed fatty acid by GLC. From the fatty acid composition the glyceride composition of natural fats and oils can be worked out.

Under a new CSIR research scheme granted to him, Shri Jyotirmoy Dutta (principal investigator) of Bose Institute, Calcutta proposes to elucidate the glyceride composition of some vegetable seed oils of Indian origin using different combinations of the above methods. Some work has been done on the elucidation of the glyceride compositions of sesame, groundnut and mustard seed oils by the lipase hydrolysis technique.

Surface Chemistry and Industrial Applications of Adsorbent Carbons

A new CSIR research scheme, sanctioned to Prof. B. R. Puri (principal investigator) at the Department of Chemistry, Panjab University, Chandigarh has for its objective the development of an elementary conceptual model for describing the surface of adsorbent carbons and study of the factors which modify the nature of the surface and affect the surface behaviour of these materials. The purpose is also to set forth some of the more significant interfacial factors and mechanisms involved in the surface phenomena associated with carbons for a more thorough understanding of the sorption processes at gas/solid and liquid/solid interfaces. The study is also expected to open up several improved and newer applications of active carbons and carbon blacks to meet the growing industrial and defence requirements of the country. Use of adsorbent carbons for various purposes, viz. abatement of air and water pollution, as catalysts in industrially important reactions, carbon molecular sieves, and preferential absorption, will also be investigated.

Influence of Chlorophenoxyisobutyrate on Energy Metabolism

The object of a new CSIR research scheme granted to Dr C.K. Ramakrishna Kurup (principal investigator) at the Department of Biochemistry, Indian Institute of Science, Bangalore is to make a systematic study of the influence of ethyl *α-p*-chlorophenoxyisobutyrate and other mitochondria-increasing substances on the subcellular composition of liver, kidney, heart, and spleen of the rat. Serum cholesterol-depressing drugs like SKF-525 will also be studied. The study is expected to throw light on the relation, if any, between serum cholesterol depression and mitochondrial increase. It is also intended to elucidate the mechanism of mitochondrial increase as well as the effect of these compounds on the integrity, quality and composition of the mitochondria.

Interaction of Proteins with Metal Ions

The interactions of metal ions with amino acids have been investigated more thoroughly than the interactions of metal ions with proteins. This is due to the non-availability of highly pure and well characterized proteins and lack of information on their three-dimensional structures. In recent years the three-dimensional structures of a large number of proteins have been determined from X-ray diffraction studies of the crystals of the native proteins and a series of their isomorphous heavy atom derivatives. It would therefore be of interest to investigate the interactions of various proteins with metal ions. A new CSIR research scheme with this objective has been sanctioned jointly to Dr T.H. Venkata Setty (principal investigator) of the Department of Chemistry, Bangalore University, Bangalore and Dr M.P. Venkatappa (co-principal investigator) of the Department of Chemistry, Karnatak University, Dharwar. The investigators propose to study the interactions of lysozyme, an enzyme present in hen egg white, with certain biologically important metal ions. It is also intended to study the effect of certain inhibitors on the interaction. The probable binding sites of the protein molecule will be identified and the changes in the conformation of the protein accompanying the metal ion binding will be investigated. Lysozyme can be prepared readily, crystallized and purified; also, its primary structure and three-dimensional structures have been established.

Effects of Pesticides on Fish and Aquatic Ecosystems

Aquatic life needs protection because of constant contamination of rivers and other waters by pesticides used widely nowadays for crop and forest protection. The pesticides, which generally drain into fish habitat as runoff, accumulate in fish tissues, fish food organisms, and bottom sediments, and thus affect the whole aquatic ecosystem. Unless a suitable technique is developed to ensure the safety of aquatic life, fish protein production will gradually decline both in quantity and quality. The object of a new CSIR scheme is to devise a direct and usable method for the protection of aquatic life from pollution. Dr S.K. Konar of the Department of Zoology, Kalyani University, Kalyani, who is the principal investigator in the project, proposes to tackle this problem as follows: (i) to determine the acute and chronic effects of commonly used pesticides on the feeding and breeding behaviour of fish, viability of eggs, survival and growth of fry, mortality, off-taste of fish flesh, resistant fish as poison-carrier to consumers, and pathology of fish; (ii) to study the effects on mortality, growth and reproduction of fish food organisms as toxicant carriers to fish; (iii) to study poison residue in soil, water, fish tissues, and in fish food organisms; and (iv) to evaluate hazards to fish and fish food from pesticides through subsurface percolation.

On the basis of the studies, the maximum permissible concentrations of various pesticides will be computed for calculating the safe application doses of the pesticides.

Standardization of the Use of Plant Growth Retardants

Growth retarding chemicals are being widely used to control growth and flowering of ornamental plants, vegetables and fruit plants. These chemicals make the plants dwarf, bushy, compact and of attractive appearance. As a result of the formation of more branches, flowering is improved. In view of these possibilities, which would be of considerable significance in the commercial cultivation of tropical ornamental plants, Dr T. K. Bose of the Birla Laboratory, Royal Agri-Horticultural Society of India, Calcutta, proposes, in a new CSIR research scheme granted to him, to standardize the use of effective chemicals by studying: (i) optimum concentration; (ii) method of application; and (iii) season and stage of growth at the time of treatment.

Electrochemical Machining of Hard High Temperature Materials

Structural materials having desirable mechanical properties at elevated temperatures are being developed to meet the growing needs of not only space technology but also of defence wards. Conventional methods of cutting, such as milling, turning or drilling, required to bring these highly alloyed materials to the required design configuration in respect of dimension and tolerance are difficult and uneconomical. New methods of shaping such materials are therefore being investigated. Precision removal of anode material by electrolytic dissolution at high current densities, known as electrochemical machining, is one such recent method developed. Although considerable fundamental knowledge of such processes has been acquired, practical application of the processes, especially the control of the machining operation, requires to be investigated thoroughly.

In a new CSIR research scheme sanctioned under the purview of the Electrical & Mechanical Engineering Research Committee to Dr V. M. Dokra (principal investigator) of Visvesvaraya Regional College of Engineering, Nagpur, it is proposed to carry out investigations aimed at the design, fabrication and working of an electrochemical machining unit to be used for the shaping of highly alloyed materials with fine surface finish.

PATENTS ACCEPTED

Indian Pat. 127706

A trowel

J. P. Kaushih & B. Dass

CBRI, Roorkee

This patent is in respect of a machine developed by the Central Building Research Institute, Roorkee for finishing green concrete panels or floors with speed and economy. The existing method of hand trowelling of concrete floors is time consuming and the resulting finish is often not satisfactory. Besides speed and economy, the use of the power trowel will ensure better quality control. The machine was originally developed for finishing horizontally cast large panels, but can be effectively and economically used for finishing large concrete floors, runways, etc.

The machine (weight 65 kg) is run by a 3-hp petrol engine/motor with a fuel consumption of 1.5 litres of petrol per hour. It can finish 100 m² of floor area per hour, and has been extensively tried for laying the floor panels in a big shed in the institute. The machine-finished floor panels have been observed to be of dense structure with a uniform top surface, free of spots, ripples and trowel marks. The machine enabled handling and finishing of concrete surfaces involving the use of coarse, dry, economical mixes of lower slump which it would have been difficult to manage by hand trowelling. The manufacturing cost of the machine is estimated at Rs 2000.

Indian Pat. 127007

Improvements in or relating to the production of greaseproof paper and glassine paper

P. P. Baruah, B. P. Chaliha, S. B. Lodh & M. S. Iyengar

RRL, Jorhat

Greaseproof paper and glassine paper find extensive applications for food packaging and as wrappers for machinery parts.

The country imports greaseproof paper and glassine paper; the import of greaseproof paper and glassine paper during 1970-71 was 675 tonnes, valued at nearly Rs 29 lakhs. A part of the requirements in regard to these items is met through indigenous production, based on imported pulp.

Greaseproof paper and glassine paper are usually manufactured from coniferous wood pulp by hydration with the help of a beater. Owing to the limited availability of coniferous wood in the country, the requirements of long fibred pulp are met through import.

The invention relates to the production of greaseproof paper from jute waste. The process consists in cooking the material under certain conditions, washing and beating it with or without prior bleaching and then sheet-forming. The greaseproof paper can be converted into glassine paper by supercalendering.

The capital investment for a 5-tonne/day capacity greaseproof paper plant is estimated at Rs 70 lakhs. The production cost works out at Rs 3630/tonne of the paper.

Indian Pat. 127798

Improvements in or relating to the new process for the production of carbon black from coal

M. S. Iyengar, R. Haque, R. K. Chakrabarti, M. L. Dutta & A. K. Singh

RRL, Jorhat

In the earlier process for production of carbon black from coal, low ash and high volatile coals were subjected to fluidized-bed carbonization at 700°C and the product was recovered from char. The invention covered by the patent relates to an improved process in which finely ground coal is subjected to flash carbonization in a fluidized bed at 1200°C, and carbon black is recovered from the flue gases by water scrubbing and electrostatic precipitation or bag filtration. Recovery of carbon black from the flue gases leads to considerable improvement in the reinforcing ability of the carbon black. The quality of the carbon black can also be varied by changing the reaction conditions.

Carbon black is extensively used as a reinforcing filler in rubber and tyre industries, and a considerable amount is imported. Production of carbon black from coal will reduce the imports and help export promotion, and provides a cheaper product.

Use of coal as raw material for the production of carbon black will meet to a considerable extent the chronic shortage of the raw material (coal tar oils and oil refinery residues), which hinders the expansion of the existing units and installation of new plants to meet the ever rising demand of carbon black for automobile tyre and other rubber product industries.

Indian Pat. 128471

Improvements in or relating to the generation of square wave from sinusoidal wave

R. Mariadoss & M. S. Iyengar

RRL, Jorhat

The invention relates to the development of a device for generation of square wave from sinusoidal wave. The device consists mainly of two different types of transistors, viz. a PNP and a NPN transistor, unlike the conventional device which consists of two similar types of transistors, viz. either two PNP transistors or two NPN transistors. The input signal is rectified by the two diodes connected in the input stage and the phase reversed by the two different types of transistors kept at their operating points. The output signal, collected through the collectors of the two transistors, will be in the form of square wave. The circuit is simple and gives quick response to the input signal. The main advantage of the new device is that the square wave thus obtained from sinusoidal wave contains both positive and negative halves of the input signal. The circuit finds application in voltage comparators, pulse generators, power amplifiers and digital and logic circuits.

Indian Pat. 126709

Improvements in or relating to the preparation of iron catalysts for hydrogenation of coal

D. K. Mukherjee, P. B. Chowdhury, J. K. Sama, A. N. Basu, N. C. Basak & A. Lahiri
CFRI, Dhanbad

For hydrogenation of coal, iron catalysts were being used previously. Various forms of the catalyst, viz. powdered oxide (e.g. red mud), or iron salts like ferrous sulphate impregnated on powdered coal from their solution in water, or a combination of the two, were used. Such catalysts were found to be inferior in activity compared to tin or molybdenum, and required higher pressures—700 kg/cm^2 as against 200-300 kg/cm^2 required in the case of tin or molybdenum catalyst.

According to the process patented, hydrogenation of coal may be carried out at lower pressures using iron catalyst. The process is based on the observation that the activity of the iron catalyst for coal hydrogenation is enhanced by the deposition of the metal in the form of hydrated iron oxide on the surface of powdered coal before it is subjected to hydrogenation.

Prior to hydrogenation, an iron catalyst (hydrated iron oxide) is applied in a thoroughly distributed state over the coal by the interaction of ammonium hydroxide with an iron salt (ferrous sulphate, ferric chloride, or ferric nitrate) solution. The active form of the catalyst is generated in situ by the reaction of hydrated iron oxide with hydrogen sulphide and hydrogen under the conditions of hydrogenation.

Addition of sulphur is known to enhance the activity of all-iron catalysts. The concentration of sulphur, or the ratio of the partial pressure of hydrogen sulphide to that of hydrogen is an important criterion for achieving maximum catalytic activity of iron.

Experimental results have shown that the percentage of conversion of coal to liquid and gaseous products is 80.7 when iron catalyst is used according to the procedure described in the patent as compared with the conversion percentage of 69.0 when iron oxide powder is used in mechanically mixed form under the same operating conditions and identical S/Fe atomic ratio. A conversion of 91·3% at an optimum atomic ratio of S/Fe was obtained when the modified method was used.

The modified iron catalyst compared well with molybdenum under identical operating conditions in batch tests when the concentration of iron was 3.7 times higher than that of molybdenum, both as metals. Although higher quantities of iron are required, the cost of catalyst per unit volume or unit weight of the product of hydrogenation is much less in the case of iron catalyst than in the case of molybdenum because of the wide difference in the costs of two metals.

The patent has also been filed in USA (178482), Australia (28153) and Canada (113106).

Indian Pat. 127289

Improvements in or relating to electrolytic preparation of lead dioxide powder

H. V. K. Udupa, K. C. Narasimham,
K. S. A. Gnanasekaran & S. Sampath
CECRI, Karaikudi

Lead dioxide powder finds various industrial applications, the most important among them being as an oxidizing agent in dyestuffs, explosive and pyrotechnic compositions and as a curing agent for liquid polysulphide polymers. It also finds limited use in high voltage lightning arresters.

Several chemical and electrochemical methods have been reported for the preparation of lead dioxide powder. Commercially, lead dioxide is produced by the treatment of alkaline red lead with chlorine. In some of the methods, not only is the reaction time-consuming but its efficiency is low.

The process covered by the patent relates to the preparation of lead dioxide powder from lead monoxide or red lead or lead hydroxide. The starting material is suspended in a solution of 0·5-2·0 *M* sodium chloride solution and electrolyzed in a divided cell having cloth or microporous rubber diaphragm, using graphite or graphite substrate lead dioxide anode and mild steel or graphite cathode. The electrolyte is agitated by air/mechanical stirrer to keep the solid, which is present only in the anolyte, in suspension. An anode current density of 2-10 amp/dm^2, a temperature of 25-65°C and an initial *p*H of 6·5 to 7·5 are the conditions of the reaction. A yield of 60-70% is obtained. It is also possible to carry out the reaction by fluidizing the suspended lead monoxide or lead hydroxide or red lead in the anode compartment, the electrolyte flowing upwards in the column; the conditions of electrolysis are the same as mentioned above.

After the electrolysis, agitation of the slurry is continued for about 30 min and the solid filtered off. It is washed with dilute ammonium acetate solution and finally with hot water to get a product of 88-92% purity.

The main advantages of the process are as follows: (i) lead dioxide of varying bulk densities (1·5-2·0) but conforming to the specifications of Defence Departments can be prepared; (ii) a wide variation of operating conditions is possible with a cheap electrolyte, and (iii) a fine powder of lead dioxide is obtained.

PATENTS FILED

135144: A new process for the manufacture of paraffin wax from slack wax, J. N. Nigam, M. Chakravarty, J. N. Baruah, H. D. Singh, P. V. Krishna & M. S. Iyengar—RRL, Jorhat.

135146: Improvements in or relating to the manufacture of a multiple-probe-head for measuring resistivity, Jaswant Singh & Kanwal Singh Balain—CEERI, Pilani.

135211: Process for making photoconductive cells, B. Singh & Indradev—NPL, New Delhi.

135212: Improvements in or relating to the production of paraffin wax and lubricating oil fractions from slack wax, J. N. Nigam, M. Chakravarty, J. N. Baruah, H. D. Singh, P. V. Krishna & M. S. Iyengar—RRL, Jorhat.

135213: Improvements in or relating to plating on steels with a fine layer of metallic chromium and chromium oxide, V. A. Altekar, N. Dhananjayan & A. K. Sinha Mahapatra—NML, Jamshedpur.

135278: Novel system for ignition and flame stabilization in afterburners and duct burners of aircraft engines, P. A. Paranjpe & K. Sivashankaram—NAL, Bangalore.

135302: An improved drum motor, S. K. Banerjee & N. A. Rao—CMERI, Durgapur.

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Chemical Research Committee: Progress of Work 1971-72

During the year under review more than 200 research projects were in operation under the Chemical Research Committee (CRC) of CSIR, of which 60 schemes were terminated and 36 new schemes sanctioned out of 87 recommended by CRC. Besides, there were about 24 Retired Scientists' schemes in operation during the same period about half of which were terminated and 5 were new schemes. With a view to helping research scientists in getting chemicals indigenously, the Committee had sponsored four research centres for the production of biochemicals most of which are at present imported; one centre is functioning at the Osmania University.

The Committee held two meetings during the year and organized a convention jointly with other organizations dealing with chemistry.

A brief report on some selected projects highlighting the important findings follows.

Organic Chemistry

Different parts of the plant *Putranjiva roxburghii* have been examined. From the leaves, new triterpenes have been obtained in addition to a number of known compounds. The new compounds are methyl putranjivate, putranjivic acid, putrone, and putrol. A number of saponins have also been obtained from this source. Chemical examination of *Croton oblongifolius* has led to the identification of new diterpenes, viz. oblongifoliol, deoxyoblongifoliol-A and B, oblongifolic acid, corresponding hydrocarbon, aldehyde and alcohol (of isopimara-7,15-diene type). 11-Dehydro-(−)-hardwickic acid and acetyl aleuritolic acid have also been obtained. A new xanthone, named Cudrania xanthone, has been obtained from *Cudrania javanensis*. From *Rhizophora conjugata*, *Rhizophora mucronata*, *Ceriops roxburghiana* and *Ceriops candolleana*, a number of proanthocyanidins have been isolated in the form of their methyl ethers and acetates. From *Cedrus deodara* and *Pongamia glabra* new types of compounds have been reported though in poor yield and their constitutions have been elucidated. Chemical examination of *Lobaria lichens* has been useful particularly in throwing light on their characteristic triterpene compounds. (Prof. T. R. Seshadri, Delhi University).

During the work on the sesquiterpenoid a number of minor components were detected in the oil obtained from North Indian vetiver roots, and attempts have been made to separate them from the intricate mixture. The transformation product of khusinol has also been studied as it is of biogenetic interest. (Prof. S. C. Bhattacharya, IIT, Bombay).

Chemical examination of *Alstonia macrophylla* revealed the alkaloids affinisine and picrinine. Deaminoxy chonemorphinone, deaminoxy chonemorphine and chonemorphine were isolated from *Chonemorphia macrophylla*. [Prof. (Mrs) A. Chatterjee, Calcutta University].

Investigations on the pigments of the sea-urchin *Stomopneustes variolaris* has yielded a dark red pigment which is considered to be a quinone. (Prof. S. Neelakantan, Madurai University).

Investigations of the leaves of *Murraya elongata* yielded two novel monomeric coumarins, murangatin and murralongin. (Dr S. K. Talapatra, Calcutta University).

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Methods for the preparation of 2,3-isomeric diol in moretanone series have been investigated by employing the diosphenols. A method for the preparation of 16-substituted triterpenes has been developed by the allylic oxidation of $\triangle^{14,15}$-triterpenes. (Dr H. N. Khastgir, North Bengal University).

A new and convenient method for the synthesis of the ABC skeleton of estrone has been developed, as also an economic process for the separation of 19-nor-steroids and estrone via 19-nor-diosgenin (Prof. S. V. Sunthankar, Bombay University).

The syntheses of 4,17 α-dimethyl-4, 17α-diaza-D-homo-5 α-androstane dimethiodide and a few more aza-steroids have been carried out with a view to testing their biological activities like neuromuscular blocking activity. (Dr Harkishan Singh, Panjab University).

Various synthetic approaches have been made towards the synthesis of a degradation product of atisine, a novel diterpene alkaloid, and related compounds. (Prof. P. C. Dutta, Indian Association for the Cultivation of Science, Calcutta).

Biochemistry

Studies with regard to lysozyme induction, method of purification and the properties of the enzyme have been made. Evidence has been obtained to the effect that the C_1 gene of P22 regulates the expression of late genes for P22 including the gene for lysozyme. (Prof. D. P. Burma, Banaras Hindu University).

Useful results have been obtained in studies concerned with: sulphatide metabolism in different stages of experimental allergic encephalomyelitis; changes in glucosaminoglycans in protein calorie malnutrition; and metabolism of cerebroside sulphate. (Prof. B. K. Bachhawat, Christian Medical College Hospital, Vellore).

Search for the species of snails available in India for yeast-lysis activity has been made. The species have been examined and the gut juice of *Pila virens* has been found to contain the maximum activity. Procedures have been standardized for the extraction, storage and efficient use of the enzyme. (Dr J. Jayaraman, Madurai University).

As part of the investigation on cactus metabolism, glycollate oxidase was studied in the phylloclades of *Napolea dejecta* and the results indicate high phosphoenol pyruvate carboxylase activity and hence β-carboxylation. This further indicates that cactus phylloclades possess both high β-carboxylation and glycollate oxidase activity. For the isolation of the respiratory particles from the total root parasite *Orobanche cernua*, procedures have been worked out and some determinations carried out also on host tissues as a preliminary to studies on the influence of parasitism on the mitochondrial activity of host. (Prof. P. S. Krishnan, Lucknow University).

Attempts have been made to purify intestinal dipeptidases and a new polyamine *sym*-homospermidine has been isolated from the leaves of *Santalum album*. A detailed study has been carried out on its biosynthesis in sandal leaves. The soluble hetero-β-galactosidases from the monkey liver and small intestine have been purified. Properties of the enzyme have also been studied. (Dr A. N. Radhakrishnan, Christian Medical College Hospital, Vellore).

Physical and Inorganic Chemistry

Mössbauer spectroscopic studies on tris-(acetoacetanilide) iron(III) sulphate, ferrous fumarate, tris-(ethylenediamine) iron(III) sulphate, and trisodium pentacyanoamine ferrate(II) have been made and some useful results obtained. (Prof. P. S. Goel, IIT, Kanpur).

Kinetic studies on the oxidation of alcohols by chloramine-T have shown that the oxidation proceeds in the acidic medium in the *p*H range 4.0-6.6. A suitable mechanism consistent with the experimental results has been formulated for each of these oxidations. (Dr S. P. Mushran, Allahabad University).

Attempts have been made to synthesize some double alkoxides and obtain information on the structure of some of these compounds by NMR studies. The existence of magnetic nonequivalence in the terminal isopropoxy group has been observed for the first time. (Prof. R. C. Mehrotra, Rajasthan University).

For studying the co-solvency of high polymers, an expression relating unperturbed dimension to easily obtainable parameters has been derived from the study of solution viscosity. Conversion time data were obtained for the polymerization of acrylamide by H_2O_2-hydroxylamine redox pair. (Prof. S. R. Palit, Indian Association for the Cultivation of Science, Calcutta).

Molecular orbital calculations on distorted hydrogen bonds formed by carbonyl compounds have been made and it has been found that while the deviation from the lone pair approach does not affect the properties of hydrogen bonds formed by these compounds, bending the bonds beyond 20° causes a large decrease in the dissociation energy. A systematic study of the electron donor-acceptor complexes formed by phenothiazine and chlorpromazine has also been carried out. Enunciation of a possible mechanism for the drug action has also been attempted. (Prof. C. N. R. Rao, IIT, Kanpur).

Thermoosmotic anisotropy was investigated and experimental results show that in general membranes are isotropic as far as thermoosmosis is concerned. (Prof. R. P. Rastogi, Gorakhpur University).

The configurational and frictional properties of poly (ethyl acrylate) and poly (butyl acrylate) were investigated in various solvent media using light scattering, osmometry and viscosity techniques. (Prof. M. Santappa, Madras University).

Industrial Chemistry

Investigations were taken up on the development of technology for the production of multipurpose grease, which is imported at present. The imported grease of wide temperature range (XG-279 conforming to U. K. Specification C. S. 3107) has been found to be essentially a mixed base grease of calcium and lead stabilized with lead soaps; bentonite, and calcium acetate complexes were absent.

Investigations were carried out to prepare various fluorine compounds of industrial importance, directly from low grade fluorspar.

For developing continuous vertical soaker-steamer and drier for parboiling of paddy, design data for cup and cone vertical drier have been collected. Studies have been carried out on a laboratory model and a pilot plant system.

Acetylated recinoleates of ethyleneglycol, diethylene, 1:2-propanediol and all the three isomers of butanediol have been synthesized and are being evaluated for their plasticization characteristics. A high vacuum distillation unit is being assembled to purify acetylated glycol recinoleates.

Conditions for preparing ionic catalysts and block copolymers of styrene with different monomers have been standardized.

Optimum Design of Transmission Line Towers and other Tower-like Structures : SERC

The fourth Five-Year Plan investment on power distribution is estimated at Rs 720 crore. During this period, some 2200 km of transmission lines are expected to be laid. As all power lines are overhead lines, transmission line towers of varying types and heights need to be designed, fabricated and erected.

To make available know-how for the design of transmission line, TV and microwave towers the Structural Engineering Research Centre (SERC), Roorkee, undertook a project on the development of an optimum design of tower-like structures. Conventional methods of analysis cannot handle such complex structures. Moreover, it is time-consuming to design a tower on the basis of conventional methods. The tower is a tall structure with cable loads acting near the top, the rest of the structure being free o applied loads. Hence the arrangement of the members in a large par of the structure is arbitrary from mechanistic and functional point of view.

The base length and width, th

number of divisions of the height of the tower into panels and numerous ways of bracing each of these panels are open to choice and hence can serve as important means to economize the design of towers. The arrangement of panels affects the fabrication also, and careful selection of configuration reduces fabrication costs and minimizes loss of rolled steel material.

In view of the crudeness of the conventional methods of analysis, power project authorities insist, before accepting the tower design, that full scale loading tests be carried out by tower fabricators. And these tests are very expensive. An efficient, fast and reliable method of analysis can obviate the tests.

Economical Tower Designs

By analysing transmission line towers as space frames on a digital computer employing matrix methods of structural analysis, it is possible to prune the weight of towers by at least 10%. Transmission line towers being 'repeat' structures built in thousands all over the country, a small saving effected in one type of tower will lead to huge aggregate savings. It is estimated that a saving of about Rs 80 crore can be effected during the fourth Five-Year Plan period if improved designs of towers are widely adopted in India by all the electricity boards. As a result of studies extending over a period of three years carried out by SERC, a computer programme for arriving at the minimum weight designs of transmission towers has been developed. This iterative process involves only two or three trials. Experience shows that the weight of towers can be pruned at least by 10% by this means.

The development work relating to the analysis and design of towers carried out by SERC consists of a fast method of matrix analysis of three-dimensional framed structures by means of computers. In addition, emphasis is laid on optimization (which means minimum consumption of steel and hence cost reduction) through selection of not only component members but also of their arrangement, i.e. selective configuration.

The research team recognized in the very beginning the importance of the rapidity of the method of analysis for success in obtaining competent designs. A computer method was accordingly adopted. This also took care of the necessary enormous computations and the handling of a large number of parameters. The latest and the most sophisticated stiffness matrix method was adopted for analysis.

Efforts towards Industrial Utilization

As the final authorities to accept tower designs are the various State Electricity Boards, Public Works Departments and the Central Water & Power Commission, the laboratory apprised the engineers of electricity boards and other departments of the new ideas before contacting the manufacturing firms. To create confidence at technical level, SERC also conducted a high level intensive course on computer methods in tower designs, which was attended by the representatives of the electricity boards. It was the experience of these engineers, who were earlier designing towers by the conventional methods, that such methods were unsatisfactory.

After developing a basic procedure for doing the job in the form of a series of computer programmes, several firms were invited to send their design requirements. Many of the designs turned out to be irrational as most of the firms were accustomed to the traditional practices which involve the use of excess material for the structure to ensure safety. It was with considerable effort on the part of SERC that the firms could be convinced that the factor of safety is often taken to be high to cover uncertainties in the analysis.

The next task of the laboratory was to contact various industries for getting their tower design problems for solution at a nominal fee. The response from the industries was highly encouraging: all the major manufacturers of towers were interested in the offer. A few electricity boards and other public sector undertakings procured the designs from SERC and attended to the fabrication and erection of towers themselves. Many firms who entrusted their design problems to SERC were impressed by the speed with which the know-how could deliver the goods.

Applications and Future Scope

A major application of the know-how and the computer programmes concerns the design of television towers for the All India Radio and of microwave towers for telecommunications for the Posts and Telegraphs Department. These towers are 8 to 10 times taller and heavier than transmission line towers. They make proportionately heavy demands on the efficiency and accuracy of design. The deformations of such towers are also to be kept within strict bounds for directed transmissions and receptions of transmitters and antennae.

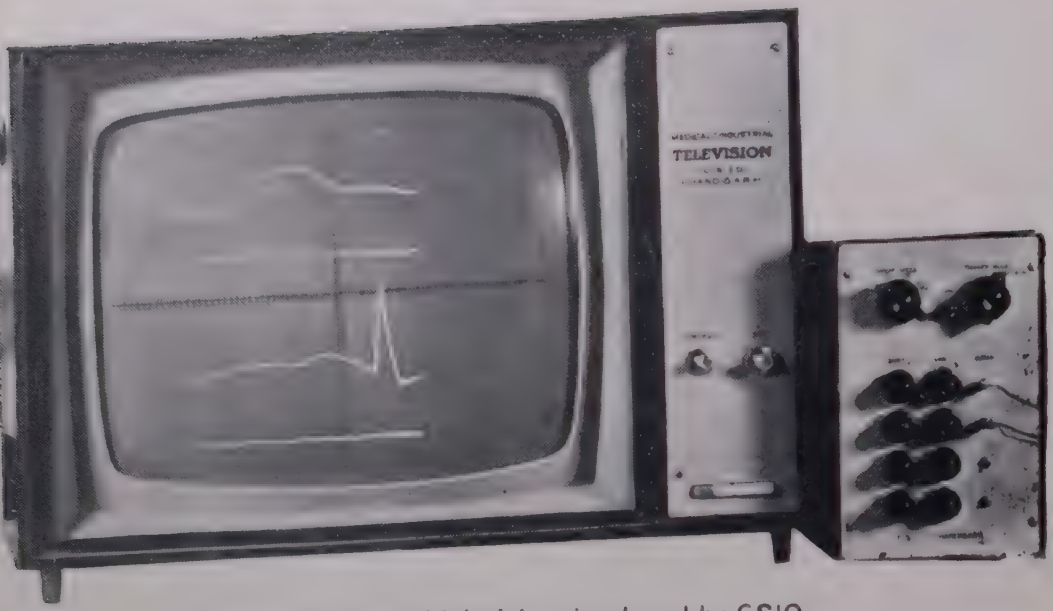
As these towers may be as high as 300 m, accurate analysis of wind stresses is of utmost importance. Analysis and designs of such large and complex structures could not have been attempted by the conventional graphical methods. The laboratory provided not only designs for microwave towers but fabrication drawings also.

The export potential for transmission line towers has also developed considerably in the last few years. Burma, Iran, Thailand, Sudan and Kuwait and many other Afro-Asian countries have awarded contracts for the supply and erection of these lines to Indian engineering firms. The prospects of capturing markets in the developing countries are becoming brighter.

The formation of the national power grid in the country, as envisaged, is bound to lead to the extensive use of the know-how for tower designs developed by the laboratory.

CSIO Develops Medical/ Industrial Television

The Central Scientific Instruments Organisation (CSIO), Chandigarh, has designed and developed a medical/ industrial television for the first time in India, using mostly indigenous components. In hospitals it finds its use for monitoring electrocardiogram, temperature, pulse, respiration and blood pressure waveforms of patients during and after surgical operations and for simultaneous clinical observation of various parameters such as fetal heart-beats of patients. In industry it is used for multi-channel display of flow, pressure, vibration and turbulence in



Medical/industrial television developed by CSIO

conjunction with suitable transducers.

The cost of production is estimated at Rs 5000 whereas the cost of an imported unit ranges from Rs 10 000 to Rs 20 000. The performance of the equipment is comparable to that of the imported one. Foreign exchange savings equivalent to Rs 15 lakhs are anticipated when indigenous production is established; also, the equipment has considerable export potential in view of its competitive price.

PROGRESS REPORTS

CFTRI Annual Report: 1970

The Central Food Technological Research Institute (CFTRI), Mysore has brought out its annual report for 1970. Besides detailed project-wise reports, the 142-page report (royal 8vo) contains a 10-page summary highlighting the more important work of the institute in the various areas of food science and technology with which the institute is concerned. Concerted efforts were made to tackle the problems of industry, as also to formulate multidisciplinary research programmes in collaboration with other research institutions, agricultural universities and concerned government organizations.

Storage of foodgrains: Studies were carried out to stablilize the pyrethrins in extracts so that they retain their insecticidal activity for extended periods; a formulation of pyrethrins with sesame oil, pyrogallic acid and bees wax was found to retain its potency for 7 weeks against *Tribolium castaneum*. The X-factor complex (the new insecticidal by-product from BHC) has been found to contain seven polychlorinated compounds. Mixed with different isomers of BHC the complex exhibits synergism. One more volatile compound from X-factor complex has been characterized as *o*-dichlorobenzene. A Lindane unit capable of handling 100 kg of BHC per batch was commissioned and trials were carried out. The yield of Lindane (92 % purity) was 7-8%. Processes have been developed for the purification of ethylene dibromide (EDB) and methyl bromide (MB), and for the production of low bulk density aluminium silicate for use as an insecticide and as an insecticide carrier. A continuous can filling unit has been designed for Durofume (EDB-MB) combinations.

Cereals and pulses: Processing and cooking behaviour of Indian varieties of rice was studied. The ratio of water uptake at 80° to that at 90° C correlated well with the gelatinization temperature of rice. A simplified method of determining amylose in rice has been developed. A simple and reliable chemical method, based on the extraction of bran pigment using 2% KOH-*n*-propanol mixture and subsequent reading of colour, has been developed for determining the degree of milling of rice. A milk like emulsion rich in B-group vitamins and containing some quantities of oil and protein was prepared from rice bran for use in various dishes.

Fourteen pure bred strains of *jowar* were tested for cooking and milling characteristics; six of them were found to be inferior to others for preparing *roti*. Pearled grains of *Yennigere*-2 and *Swarna* varieties could be cooked into soft product. Following the success in improving the milling outturn of red gram, investigations have been extended to other pulses like black gram, Bengal gram and green gram.

Oilseeds and protein foods: The peanut protein isolate has been found to be a suitable substitute for *khoa* in *burfi*. Products prepared by using protein isolate at 2.5-10.0% levels of *khoa* had the same acceptability as market products. Know-how has been developed for producing low fat amino acid supplemented groundnut kernels containing 26% oil and 37% protein. Fifty to sixty per cent of the oil can be reduced in the nuts by this process. More than 5 tonnes of black variety sesame seed were dehusked by the institute's wet dehulling process, and yielded a product low in oxalates and free from black colour. The defatted, methionine-rich edible flour obtained from dehulled seed was supplied to food industry. Cost estimates of the processed products were worked out. A technique has been worked out for recovering the residual gum in commercial guar meal. The detoxified meal containing 60% protein could be safely used at 10% level in poultry feeds.

Fruits and vegetables: Studies on the preservation of bananas and mangoes in fresh state to extend their inland as well as overseas trade were continued. Pre-harvest spraying of Benlate (fungicide) and subsequent painting of the cut ends of bananas with antifungal paste (Brassicol and Benlate/Thiabendazole) were found to prevent fungal growth even after smoking and ripening of fruits which had been kept in cold storage for 26 days. These formulations will substitute the imported products.

The fungal spoilage of *Alphonso* and *Pairi* varieties of mangoes could be prevented by dipping them in hot water containing Aureofungin or Captan before cold storage. Storage of fruit for 24 days at 50°F and subsequent dipping in hot water containing Ethrel resulted in simulated ripening and also prolongation of storage life by 3-4 days at room temperature. The results are significant from the point of veiw of promoting the export trade, inland as well as overseas, of fresh mangoes.

Post-harvest treatment with wax emulsion containing Benlate was found most effective in preventing fungal infection in *Nagpur Mandarin* oranges. It reduced the spoilage from 15% to less than 5% at room temperature during storage. An improved technique was worked out for producing powdered pectin with low ash content, without recourse to alcohol precipitation, from lime peels. At the instance of Defence Services, the institute carried out studies aimed at improving the storage life of dehydrated potatoes; raising the level of SO_2 in the product was found to increase the storage life of potatoes.

Meat, poultry and fish: A dehydrated minced meat containing 50% vegetable protein has been developed. The product can be dried in the form of chunks which have satisfactory qualities of rehydration and holds promise of consumer acceptance.

The free amino acid (FAA) pattern of different species of shrimps was investigated. Shrimp stored in ice for 5 days showed a significant drop in glycine. Canned shrimp showed low FAA content. Addition of glycine, glutamic acid, and proline before cooking enhanced the flavour of shrimps, the enhancement was marked when inosine monophosphate was added along with the amino acids.

Conditions have been standardized for partially hydrogenating sardine oil. Fish protein hydrolysate has a greater antioxidant effect on sardine oil than fish protein concentrate, but discolours the oil to a greater degree.

Spices and flavour: Dry ginger (220 kg) was processed for oleoresins (yield of volatile oil, 1.68%; and oleoresin, 5.63% wt/wt). Ultraviolet and infrared spectral studies of mango aroma concentrate in chloroform indicate the presence of a $\alpha:\beta$ unsaturated ketone and confirm the earlier findings. It was also found that *Acacia* gum could 'lock in' more aroma of mango than dextrin.

Tea: A colorimetric method was standardized for estimating traces of alcohols present in the steam distillate of black tea of South India. The maximum activity of tea enzymes responsible for the formation of carbonyl compound occurred at *p*H 6.2 and 37°C. The enzyme is not a transaminase but one that is responsible for the degradation of amino acids. Teas of superior quality were found to contain more of theaflavin in their caffeine-polyphenol complex than those of inferior quality.

Microbiology: Spun-pipe cement tanks, which are inexpensive and easy to fabricate and erect, have been found suitable for the fermentation of fruits to make wines. *Bangalore Blue* grapes (500 kg) and cashew apple (500 kg) were fermented in such tanks to obtain good quality grape wine and cashew brandy respectively. Sub-standard bananas rejected during export have been used (after cold storage) to produce acceptable brandy with the characteristic flavour of this fruit. Two species of fungi, viz. *Rizopus chinensis* (IFO 4737) and *Botryodiplodia theobromae* (isolated from coconut kernel), showed promise for production of protease.

Applied nutrition and dietetics: A low cost balanced food based on 70 : 30 blend of wheat flour and soybean flour, and fortified with vitamins and minerals has been prepared. Included at 10 and 20% levels, this food supplemented effectively rice and *ragi* (*Eleucine coracana*) diets respectively. Techniques for the preparation of total carbohydrade fraction and also starch from legumes were standardized.

Biochemistry: Work was mainly concerned with fundamental aspects of plant, animal and microbial biochemistry. Lipase from rice bran was purified and concentrated 60-fold, and its properties were studied. It was more active on rice bran oil than groundnut oil. The NADH-cytochrome reductase was also purified from cotyledons of fresh beans of *Phaseolus vulgaris*. Trypsin resistant phosphopeptides of casein did not enhance the absorption of either calcium or phosphate ions from small intestines of anaesthetized rat, but enhanced the transfer of calcium from intestine to blood and tissue. Rats fed on low protein, pyridoxine deficient diets, on supplementation with protein and pyridoxine, showed increased level of mitochondrial and supernatant aspartate aminotransferase.

Equipment: An improved citrus juice extractor was designed and a unit was fabricated. Other items of equipment designed and fabricated include: heat coagulation unit for leaf proteins; pneumatic air classifier; and bran stabilizer working on the principle of frictional heat. Designs of pilot plant units were also prepared for cyclone separator for pneumatic drier, jacketed still, humidity chambers, tamarind juice concentrators, a simple sheller and a low pressure extruder for paste goods.

Four surveys conducted during the year relate to: (1) handling, distribution and marketing of poultry; (2) storage of pulses in traders' godowns in Bombay; (3) incidence of internal breakdown in *Alphonso* mangoes; (4) potential market for high density polyethylene containers in the fish trade.

As many as 3317 technical queries were answered and 122 parties were given assistance in the solution of technical problems. One hundred and five papers were published during the year.

CSIR SUPPORT TO RESEARCH

Completed Schemes

Cytoecological Studies on *Rauvolfia serpentina* and *R. tetraphylla*

A cytological study of *Rauvolfia serpentina* and *R. tetraphylla* has been carried out by Dr (Mrs) R. Banerjee, under a CSIR fellowship, at the Department of Botany, Ranchi University, Ranchi. An ecogeographical correlation with chromosome number and chromosomal constitution is indicated. Examination of field-grown plant populations failed to reveal any consistent correlation between chromosome number and growth behaviour; however, appreciable variations in leaf shape and size, floral character and reproductive vigour present a complex picture. Variations exist not only in these two species but in different populations of the same species.

Cytological observations of four populations of *R. serpentina* from widely separated localities exhibit

$2n=22$ chromosomes with variation in a few plants of Dehra Dun population showing $2n=44$ chromosomes. All the five populations of *R. tetraphylla* show $2n=66$ chromosomes, with variation plates showing $2n=88$ chromosomes in the same root tips of Australian population.

The chromosome number and chromosome association of *R. tetraphylla* strongly suggest its polyploid nature. Cytological studies of the two species clearly indicate the existence of a polyploid series with a basic chromosome number $n=11$ in the genus. Polyploids generally exhibit a wide range of ecological plasticity than the diploids. The present study also shows that *R. tetraphylla*, an allohexaploid species, has wider geographical range than the diploid *R. serpentina*.

The chromosomes of *R. serpentina* and *R. tetraphylla* show wide variations with respect to their size, positions of centromere and number of satellites. Appreciable differences have been observed in different populations of *R. serpentina*. The chromosomes of *R. serpentina* are generally long, having one pair to three pairs of sat-chromosomes, whereas chromosomes of *R. tetraphylla* are short and possess only one pair of sat-chromosomes. The sat-chromosome of *R. tetraphylla* is smaller in size than that of *R. serpentina*. Asymmetry of sat-chromosome has also been observed in different populations of *R. serpentina*.

The meiotic behaviour of *R. serpentina* reveals that meiosis is highly irregular in some populations. As a consequence, pollen grains are mostly sterile. At metaphase, high frequency of univalent and multivalent configuration and lagging univalents, sticky chromosome and bridge formations at anaphase suggest an incompatibility in parental species, which is a reflection of genic imbalance. It seems probable that both genic and chromosomal sterility exist in these populations. Low seed output in these populations has been attributed to high meiotic irregularities. This is further confirmed when crossing between two populations, one having low meiotic irregularities and the other with high meiotic abnormalities, is carried out. Reproductive vigour has been found to improve when fertile pollen grains are placed on male sterile plants of another population.

Low doses of irradiation have been found to reduce the meiotic irregularities to an appreciable extent, resulting in the production of healthy seeds. As a consequence, the output of healthy seeds has been found to increase.

An interesting feature of the meiotic behaviour of *R. tetraphylla* is the occurrence of secondary associations of bivalents at metaphase. Attachment of bivalent to nucleolus and secondary association suggest its tetraploid ancestry. The species is an allohexaploid and is assumed to have arisen by somatic doubling of sterile hybrid as a result of crossing between diploid and tetraploid species.

Wide variation has been noted in the alkaloid content of the two species of different populations. The study also reveals that the alkaloid content is highly influenced by irradiation. Since irradiation changes the genetic set-up of the species, it is inferred that variation in alkaloid content is genetically controlled. Variations in the active principle of different populations have also been attributed to genetic variation as the populations under study have been grown under uniform environmental conditions.

New Schemes

Design and Development of a General Purpose Digital Computer

Under a new CSIR research scheme granted to Prof. G. N. Garud (principal investigator) of the Visvesvaraya Regional College of Engineering, Nagpur, it is proposed to design and develop a general purpose digital computer using indigenous components. It would be mainly used for educational purposes and would be cheap. The machine could also be used as an electronic calculator in business houses.

Biostratigraphical and Palaeoecological Studies of the Jurassic Rocks of Kutch

Kutch (Gujarat) is known the world over for the rich and excellent fossil faunas preserved in its Jurassic rocks. Investigations on the general geology of Kutch and on certain groups of fossils date back to the beginning of this century or the end of the last century and hence need revision. Recent work is mainly confined to taxonomic descriptions of only two groups of fossils, viz. Cephalopods and Lamellibranchs.

Prof. S. K. Agrawal of the Department of Geology, Banaras Hindu University, Varanasi, proposes to carry out biostratigraphical and palaeoecological studies of the Jurassic rocks of Kutch under a new CSIR research scheme granted to him.

Studies on Potential Antiradiation Drugs of Thiazolidine Series

Thiazolidine carboxylic acids are potential antiradiation compounds by virtue of the presence of the basic pharmacophoric moiety [-S-C-C-(C)-N-], in which a sulphur atom is separated from the basic nitrogen by two or three carbon atoms. These compounds can break down to cysteine *in vivo*, which is a proven protective agent. Thus, substitution on carbon-2 of the thiazolidine carboxylic acid will control its ring opening process to form cysteine and offer protection. With appropriate substituents, prolonged protection could be offered by maintaining a steady *in vivo* level of cysteine. Several derivatives of thiazolidine carboxylic acid have been prepared at the Bombay College of Pharmacy, Bombay, and three derivatives, viz. 2-ethyl, 2-methyl-thiazolidine-4-carboxylic acid, 2-cyclopentyl-thiazolidine-4-carboxylic acid, and 2-phenyl-thiazolidine carboxylic acid when tested on mice exposed to 850 r of X-rays were found to offer protection.

In a new CSIR research scheme sanctioned to Dr H. P. Tipnis (principal investigator) of this College, it is proposed to: (i) synthesize various derivatives of thiazolidine carboxylic acid; (ii) screen the compounds for possible radiation protective properties; and (iii) study the ring opening mechanism of these compounds. The ultimate objective of the project is to develop antiradiation compounds for use in medicine, agriculture and food preservation.

PROCESSES & PRODUCTS READY FOR COMMERCIAL UTILIZATION

Iron Powder from Millscale

Iron powder finds wide application in the production of welding electrodes, in flame cutting and in the manufacture of sintered metal components. It is also used as a reducing agent in the manufacture of chemicals. Millscale produced during rolling operations in steel rolling mills is the main raw material required for the manufacture of iron powder.

The hitherto known method for producing iron powder from millscale is by thermal reduction at high temperatures with reducing gases like hydrogen or hydrocarbons. The electrolytic method involves bringing the iron compounds into solution and other subsequent operations such as filtration. Further, it is cumbersome to get the millscale into solution.

Process : The electrochemical method developed by the Central Electrochemical Research Institute (CECRI), Karaikudi, is free from these drawbacks. It consists in the direct reduction of millscale in the solid phase by keeping it as a sediment in an alkaline electrolyte on a suitable cathode substrate. The insoluble anode is kept immersed in the free electrolyte above the sediment of the oxide. Direct reduction has the following advantages:

(1) It eliminates the intermediate steps of bringing the iron compound into solution and electrolyzing subsequently.

(2) Handling of a large volume of solution is avoided.

(3) The process is simple in operation.

(4) The particle size of the end product can be largely controlled by the particle size of the starting material.

The present demand for iron powder has been estimated at 600 tonnes/annum.

The process has been studied on a laboratory scale. Trials were initially conducted with a 10-amp cell, and the process was scaled up to 100-amp cell, processing 4 kg of millscale per batch at a current density of 10 amp/dm^2.

Millscale, caustic soda and stabilizer are the main raw materials needed in the process.

The items of plant and machinery required for the process are : cells, anode assembly, rectifier and accessories, annealing unit, centrifuge, ball mill and sieving arrangement, water demineralizer, and miscellaneous items like tank, washing unit and storing unit.

The total investment for putting up a plant of 150 tonnes/annum capacity has been estimated at Rs 6.60 lakhs, comprising a fixed capital on building (about 2500 ft^2) of Rs 50 000; a fixed capital on plant of Rs 4 32 0000; and a working capital of Rs 1 68 640.

Further particulars may be obtained from: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

Fatigue Testing Machine

Fatigue life and location of fatigue failure of metal specimens subjected to alternating stress cycles are determined by this machine. High operating speeds of modern machines and the extreme stress ranges to which the materials of construction are subjected make fatigue testing a necessity. Fatigue testing of materials is an important pre-requisite for the construction of structural components like aircraft parts. Fatigue testing machines are presently imported.

The National Aeronautical Laboratory (NAL), Bangalore, has developed a fatigue testing machine (Indian Pat. 112037) which is supported as a cantilever and loaded by dead weights applied at the free end through self-aligning bearings which permit both vertical loading and the rotation of the specimen. A counterbalancing lever system is used to balance the dead weight of the loading assembly. The specimen is rotated by an induction motor. A cut-out switch is provided to stop the machine when the specimen fails. To record the total number of cycles to failure, a six-digit counter is fitted to an extension of motor shaft through a reduction gear.

The specifications of the machine are as follows: capacity, 300 in. lb (bending moment); specimen, 12.70 cm length and 1.27 cm diam at shoulders; speed, 300 cpm; motor, 0.5 hp, 50 cycles, 3-phase; machine dimensions, length 1.40 m, width 0.63 m and height 1.27 m; weight (including tables), 227 kg (approx.).

The machine is useful for evaluating materials on the basis of S-N-curve according to British Standard specification No. 35/8 Part 2: 1962.

A prototype of the machine has been designed and fabricated at the laboratory. Tests have shown that its performance to be satisfactory.

The fixed capital for setting up a plant with a minimum economic unit of 10 devices/annum has been estimated at Rs 1.5 lakh, and the cost of production has been estimated at Rs 8000 per device. The plant and machinery required for the plant comprise: lathe (Rs 15 000), milling machine (Rs 50 000) and drilling machine (Rs 5000).

Various components required for fabricating the machine (per unit) include: motor (5 hp); six-digit veeder root counter; springs; sight feed lubricator; mounting table; weights; and electrical controls such as transformer, air break contactors, limit switches, push buttons and indicating lamps.

The raw materials required are castings for bed and bearing housing, mild steel (20 kg/unit), stainless steel (20 kg/unit), and brass (2 kg/ unit).

Further particulars may be obtained from: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

PATENTS ACCEPTED

Indian Pat. 128381

Improvements in or relating to the reduction of phosphorus content of high phosphorus manganese oxide ores

S. B. Kanungo, B. R. Sant & G. S. Chowdhury
RRL, Bhubaneswar

India is one of the major manganese ore producing countries in the world, contributing to about 9% of the world production of the ore. About

95% of the manganese ore produced in the country is used in iron and steel industry, mostly in the form of ferro-manganese. The ore used for ferro-manganese production should not contain more than 0.15% phosphorus as it goes into the metal during smelting in the blast furnace. High phosphorus content in the metal leads to the deterioration of the mechanical properties of the steel, particularly the impact strength. A large amount of Indian manganese ores contain high phosphorus and, therefore, cannot be used directly for matallurgical purposes unless blended with low phosphorus ores. Conventional ore-dressing methods to reduce phosphorus content have met with little success and, therefore, different approaches such as chemical methods become necessary.

The process covered by the patent concerns the reduction of the phosphorus content of high grade manganese ores of Koraput district containing high phosphorus. Finely ground ore is mixed thoroughly in suitable proportions with sodium hydroxide or sodium carbonate or a combination of the two and roasted at a temperature between 700° and 1000°C. The principle of the method lies in the conversion of the combined phosphates present in the manganese ore into water-soluble alkali metal phosphates. This treatment brings about a partial solubilization of silica and alumina present in the ore. The roasted mass is leached with water and the slurry is filtered and washed free of soluble salts. The residue is dried at 105-110°C. The product needs agglomeration for use in the ferro-alloy industry.

The effect of various parameters like the amount of sodium hydroxide and/or sodium carbonate, roasting temperature, duration of roasting, particle size of the ore and pre-roasting of the ore has been studied and optimum conditions have been worked out for reducing the phosphorus content of the high grade manganese ores of Koraput area. The phosphorus content has been reduced to the extent of 70-90% depending on the amount of alkali used. Since the nature and composition of the ore vary from place to place, optimum conditions for the maximum removal of phosphorus will be different for different ores. For low grade ores containing high gangue materials, pre-beneficiation by simple ore-dressing methods will economize the consumption of alkali.

Indian Pat. 127174

A process for recovery of zinc and carbon electrode from waste dry cells

M. S. Iyengar, J. L. Ghose, R. K. Chakrabarti & R. Haque
RRL, Jorhat

Zinc is an essential element of nonferrous metallurgy and a large quantity of it and its alloys are imported every year. A considerable amount of carbon electrode is also imported. The process under patent leads to the recovery of unreacted metallic zinc to the extent of about 90% and the carbon electrode left after cell reaction. The process consists in cleaning the metallic surface followed by smelting the metal under specified conditions. The electrode is also revivified by subjecting it to heat treatment under stipulated environmental conditions.

Indian Pat. 127173

A process for production of activated carbon from low rank caking coals

M. S. Iyengar, M. L. Dutta, R. K. Chakrabarti & R. Haque
RRL, Jorhat

Low ash activated carbons have several uses in chemical and pharmaceutical industries. A considerable amount of this material is still imported. Low rank caking coals, especially those from Assam coalfields, which are also low in ash content are extremely suitable for conversion to the above grade product. The process covered by the patent concerns the production of activated carbon from low rank caking coals. Low temperature chars obtained from these coals by flash carbonization at 600-700°C in the fluidized bed are subjected to activation by superheated steam. The product is acid-treated, washed free of acid and dried. The ash content of the product varies from 5 to 10%. A product containing still lower percentage of ash may be obtained if the coal used is initially beneficiated by floatation over a liquid of specific gravity 1.25; no chemical is needed for activating the char.

High temperature chars obtained by fluidized-bed carbonization of these coals at 1200°C can also be activated by this method to obtain medium grade activated carbon.

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135147: Improvements in or relating to electropolishing of mild steel, B. A. Shenoi & A. Palamalai—CECRI, Karaikudi.

135279: A process for the manufacture of self-adhesive photo albums, paper envelopes and the like products, S. P. Srivastava & M. S. Iyengar—RRL, Jorhat.

135303: A process for the production of proteolytic enzyme bromelin from pineapple, K. P. R. Pillai, J. N. Nigam, M. Chakravarty, J. N. Baruah & M. S. Iyengar—RRL, Jorhat.

135304: An improved die for making glass headers, D. Singh & G. S. Sidhu—CEERI, Pilani.

135347: A process for the production of compressed and active dry baker's yeast by molasses fermentation, B. K. Lonsane, J. N. Nigam, H. D. Singh, M. Chakravarty, J. N. Baruah & M. S. Iyengar—RRL, Jorhat.

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124893: Process for the preparation of methyl bromide, H. M. H. Bhavanagary & S. K. Majumder—CFTRI, Mysore.

125222: An improved process for the production of pure sodium fluoride, B. C. Kar—NML, Jamshedpur.

Thirteenth Seminar on Electrochemistry

With reference to the announcement appearing in *CSIR News* dated 15 June 1972 (p. 88) the last date for the receipt of papers along with abstracts has been extended to 25 August 1972.

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Solar Energy Working Group Meeting at CBRI

The fourth meeting of All India Solar Energy Working Group held on 6-7 July 1972 at the Central Building Research Institute (CBRI), Roorkee, took stock of the progress of work on the utilization of solar energy in India since the last meeting. Besides CBRI and the Central Salt & Marine Chemicals Research Institute, Bhavnagar, some nine institutions in the country participated in the meeting.

Prof. Dinesh Mohan, Director, CBRI, and chairman of the inaugural session, stressed in his welcome address the need for coordination between universities and research institutions in this field, as in other fields, and stressed the need for greater efforts toward making simple and cheap solar devices. Describing the various uses of solar energy, Dr K. N. Mathur, Emeritus Scientist, National Physical Laboratory, New Delhi, pointed to the vast scope for harnessing solar energy in India where the average solar radiation intensity is about 5000 kcal per square metre per day.

Progress Reports

Work done at CSMCRI, Bhavnagar, on the utilization of solar energy was reviewed by R. L. Datta of this institute. Solar stills for individual use, designed and fabricated at CSMCRI, were reported to be ready for commercial utilization. (*See* p. 125).

Giving a resumé of the work done at CBRI, H. P. Garg of the institute said that studies on domestic solar water heater, large sized solar water heater and built-in storage type solar water heater were completed and work on solar room heater was in progress. The Defence Laboratory, Jodhpur, is also engaged in work relating to solar stills, solar space heater and water heaters as reported by a worker from this laboratory. The development of a solar airconditioner at the Indian Institute of Technology, Madras, was reported ; the development of such a system was also reported by a worker from the University of Roorkee. Investigations being carried out at Motilal Nehru Regional Engineering College, Allahabad, on solar drying and the effect of various treatments on indoor temperature in factory buildings were dealt with by one of the speakers. According to a speaker from the Forest Research Institute, Dehra Dun, solar energy can be economically used for timber seasoning. The work done at Central Arid Zone Research Institute, Jodhpur, as surveyed by one of the scientists from this institute, was concerned mostly with the measurement and frequency analysis of solar radiation data.

Research Papers

A generalized procedure to predict the dynamic performance of solar energy systems at any place from the experimental data available for the test place was reported from the Department of Engineering Technology, International Centre of Education, Shri Aurobindo Ashram, Pondicherry. How CBRI design data for domestic solar water heaters can be used for single-pass industrial solar water heating was evident from this work.

A paper from IIT, Madras, reported the results of experiments performed on an absorption tower for solar airconditioner. It has been found that an air velocity of 1.25 m/s gives the optimum value of the number of transfer units. In another paper, a cycle with the help of which steam can be produced using the well-known solar heat pump was proposed.

An indirect arrangement for drying peas using solar energy was described by a worker from Motilal Nehru Regional Engineering College, Allahabad.

H. P. Garg and K. R. Rao (CBRI, Roorkee) discussed a mathematical model for the performance prediction of solar room heater. An iteration scheme which is most suited for a digital computer solution has been adopted for determining the resulting increase in room temperature. In another paper, H.P. Garg and coworkers discussed the effect of flow rates, various control systems, interconnection of absorbers and storage size on absorber area and vice versa on the overall performance.

The results of investigation on a simple solar operated desert survival kit for obtaining potable water from soil moisture, succulent plant materials and brackish water were reported from Defence Laboratory, Jodhpur.

An interesting paper from Forest Research Institute, Dehra Dun, dealt with the design of a solar timber seasoning kiln and observations made on its use: one inch thick green planks could be seasoned without increased drying defects in 3-4 weeks in the kiln as against 2 months generally required in normal air-drying.

A paper from Birla Institute of Technology and Science, Pilani, described the studies on the performance of a vacuum type solar water heater in which the storage tank can be placed in the level of the solar absorber. Various simple designs of solar hot box were discussed by a worker from Khadi & Village Industries Commission, Ahmedabad.

Special Lectures

C. P. Gupta (Department of Mechanical Engineering, University of Roorkee, Roorkee) discussed the energy spectrum of the world and the possibilities of using solar energy for airconditioning. He described a cycle based on Australian work where rock pile thermal storage is used for heating and cooling the house using solar energy. H. P. Garg (CBRI, Roorkee) described how the solar collector configuration is optimized to give maximum efficiency per unit cost. The design of solar water heater and its economics were also discussed.

In the final discussions, the question of establishing an Indian Chapter on Solar Energy of the International Solar Energy Society was discussed. The need for a solar energy centre to coordinate all the activities was felt, and a committee under the chairmanship of Prof. Dinesh Mohan (Director, CBRI, Roorkee) was formed to look into its possibilities.

Management Training Programme, CSIR : Case Workshops at NAL

In view of the need being increasingly felt for introducing modern management methods in the field of scientific research and development following the implementation of the recommendations of the Committee of Enquiry (CSIR), the Research Survey & Planning Division (RSPD) of CSIR has launched a scheme of management training for CSIR officers/staff at various levels of administrative and scientific cadres.

So far as the management training is concerned, the ambit of activities of CSIR laboratories has been broadly categorized as (i) actual research—its planning and evaluation, (ii) materials management, (iii) administration of R & D, and (iv) management accountancy, covering respectively the research scientists, stores and purchase officers, the administrative and section officers, and accounts officers.

The syllabus and curriculum of the training programme are being prepared in collaboration with the Administrative Staff College of India, Hyderabad. As a prelude to the introduction of these courses, two workshops, one on Administrative Management and another on Materials Management, were held at the National Aeronautical Laboratory (NAL), Bangalore, from 22 to 26 May 1972 with the participation of personnel from scientific research and administration. The workshops were intended to thrash out problems of R & D management, to elaborate syllabuses and to build up the faculty for future training courses.

The selection of the two subjects, viz. administrative management and materials management, was motivated mainly by the relative urgency of the problems being faced by CSIR organizations in these fields. In the context of the proposal of delegation of authority to the directors of national laboratories, the role of laboratory administration becomes all the more significant and the training courses on administrative management should be viewed against the background of the reorganization of CSIR. The question of procuring right type of materials at proper time and at economic prices has been vexing the scientists and administrators and consequently the issue of materials management assumes importance.

Many methods of imparting management training are available at present, but the case method was chosen for use in the workshops on the two subjects selected. This method has been found useful in identifying the practical management problems through the cooperation of the participants.

It was decided to make each of the workshops an integrated organizations entity wherein a single problem was viewed from different focuses. As a consequence, it was decided to invite scientists, administrative officers, section officers, stores officers and accounts officers, 28 in all, from twelve national laboratories. All these personal interacted for building up a consolidated viewpoint on each subject matter. The participants had the opportunity to get together with the scientists and administrators of the Central Food Technological Research Institute (CFTRI), Mysore, and discuss some important points on the needs of the CSIR management training programme.

Forty case leads were introduced by the participants for discussion. On the materials management side the case leads centred round such problems as organizational set-up of purchase and stores sections; interactions among the research scientists and the stores/purchase officers; procurement of stores vis-a-vis project-oriented research; merits and demerits of rate contract system and tender system; stock certification; local purchases; and procedural bottlenecks. The scientific method of presenting the case problem was followed by discussions at a high level of expertise. Similarly in the administrative workshops the main case problems discussed included: grant of study leave facilities to scientists, anomalies in the promotion procedures of administrative officers (grade II)/section officers, incidence of overtime allowance, and increases in medical reimbursement bills, etc.

There was consensus in the workshops that the case leads, when fully developed, could serve as the basis for developing a syllabus for future courses on (i) administrative management and (ii) materials management. Moreover, a confidence was created that internal faculty resources could be raised for manning the CSIR training programmes.

Hazards of Mycotoxins in Foods

Recent studies reveal that aflatoxin, a toxin produced by a fungus in stored food materials, is one of the causes for the liver disease cirrhosis in infants. An extensive survey carried out by the Central Food Technological Research Institute (CFTRI), Mysore, and other research institutions shows that significant amounts of aflatoxin are ingested by people through various food materials.

Experts from eight research institutions who met at CFTRI on 5 July 1972 stressed the need for protecting stored food materials from fungal growth, which is known to be highly hazardous to human and animal health. The meeting was held to discuss problems relating to mycotoxins in foods and their possible involvement in diseases. The experts recommended that food materials consumed in the different regions of the country should be surveyed in order to assess the amount of toxin intake by the people. Further, they recommended the popularization of methods developed for the prevention of fungal growth in foodgrains and inactivation of the toxins and intensification of studies to improve the existing methods to cover a wide variety of food materials.

Another recommendation urges the development of suitable solvent mixtures to extract mycotoxins in foods and further improvement of chemical methods to inactivate them. Also, adequate measures should be taken to stipulate standards for minimizing mycotoxins hazards. (*See also* p. 124.)

Development of Silicon Nitride: CGCRI

The development of silicon nitride, a promising refractory material for special applications, has been investigated by the Central Glass & Ceramic Research Institute (CGCRI), Calcutta. The possibility of synthesizing silicon nitride by different routes was studied using thermodynamic data. Reaction sintering of commercial silicon in a nitrogen atmosphere to produce silicon nitride with and without the use of catalysts was investigated. Alkaline earth fluorides, especially BaF_2, were found to have a marked effect on the rate of reaction in the initial stage. The reaction kinetics followed the equation $X=K \log (1+at)$ [for $X<0.75$], where X is the fraction of silicon reacted, t is the time of reaction and K and a are constants. Reaction sintering at temperatures below the melting point (1350°C) of silicon takes as long as 8 days for completion. This may be cut down by a two-stage nitridation process. Silicon nitride bodies of hollow and solid shapes (max size, 6×2 in.) have been produced in the laboratory. Most of the products were covered with a silky white wool. The interior colour of the nitride bodies was dark grey. The characteristics of the laboratory-prepared product (Si_3N_4, mainly β with some amount of α) are as follows:

Articles made of silicon nitride developed at CGCRI, Calcutta

Bulk density	: 2.22 g/cm³ (theoretical 3.18 g/cm³)
Porosity	: 24-25%
Coefficient of expansion (α)	: 1.37×10^{-6} (25-1000°C)
Transverse strength (for bodies pressed at 3 tonnes/in²)	: 11 to 12×10^3 psi
Corrosion resistance	: resistant to most molten metals
Heat effect	: DTA of a powdered sample does not show thermal peak up to 1450°C
Microstructure	: consolidated silicon nitride, dark patches of silicon nitride and a felty wool
Melting point	: sublimes above 1900°C.

Silicon nitride wool formation was often observed, and the conditions under which wool formation was accelerated were determined. The wools appear under a microscope as curled and bent colourless fibres. The formation of whiskers in the form of dendrites was also observed. Further detailed studies are under way.

Kerosene and Diesel Oil from Refinery Residues

The Central Fuel Research Institute (CFRI), Dhanbad, has developed a catalyst and worked out a process for the production of kerosene and diesel oil from heavy stocks of petroleum such as vacuum distillates and residues. Presently, a very expensive imported catalyst is used whereas the catalyst developed by CFRI is relatively less expensive and is prepared out of indigenous materials. The technique of preparation of the catalyst is simple and it imparts to the catalyst the special property required for higher selectivity and for obtaining products of superior quality. In the process developed (employing a heavy stock from an Indian refinery) the production of gas was below 5% of the feed. Total conversion of feed to products boiling up to 350° was more than 95%, of which the kerosene and diesel oil fraction was as high as 55% on a once-through basis. The maximum yield of kerosene and diesel oil was increased to 85% (by volume) by recycling and by appropriate choice of the operational variables, viz. temperature, pressure and residence time. The kerosene obtained had a saturates content of nearly 80% (by volume) and the diesel oil had a diesel index of 65.

This work is of special significance to the Indian Oil Corporation Ltd who are contemplating to use in their refineries the crude oil from Middle East (Agazari) which contains a large volume of residues (up to 30%).

Food Industries in India: Directory

Consolidated information on more than 10 000 food manufacturing and allied industries in India has been published in a directory, the Directory of Indian Processed Food and Allied Industries, brought out recently by the Central Food Technological Research Institute, Mysore. The directory lists industries in each specialized area concerning beverages, biscuits and other bakery products, cereal products, confectionary, dairy products, fruit and vegetable products, fish and other sea foods, meat and poultry products, nuts, processed protein foods, milling industries, food additives, packaging materials, spices, condiments and *masala* powders, sugar, vanaspati, food machinery and equipment, and insecticides and pesticides. Also included in the directory is information on research organizations, government agencies and training institutes concerned with food industry. A section on food laws, regulations, and standards has also been included for ready reference. A list of journals devoted to food science and technology is also given.

In terms of the volume of production the food industry is the largest in the country. It is only through a directory of this kind that the magnitude of this industry's efforts toward making the country self-sufficient, toward increasing the employment potential and improving the nutrition standards can be realized not only by the industrialists but by the research workers and government departments.

The 856-page directory covers nearly 95% of the food industries in the country, and is priced Rs 50. Copies can be had from the Director, Central Food Technological Research Institute, Mysore 2.

PROCESSES & PRODUCTS READY FOR COMMERCIAL UTILIZATION

Weaning Foods

In developing countries, the dietary pattern of young children during the post-weaning period is predominantly based on cooked cereals and cereal gruels and includes negligible quantities of protective and protein rich foods, such as milk, meat, fish and eggs. As a result of dietary deficiency in respect of proteins, vitamins and minerals, protein malnutrition and other deficiency diseases are strikingly seen in weaned infants and young children belonging to the low income groups of the population. The acute shortage and the high cost of milk in developing countries and dwindling supplies of skim milk powder from other countries underline the need for the development of nutritious and acceptable processed food formulations based only on readily and locally available plant proteins such as edible oilseed meals and pulses.

Process : With a view to meeting the protein needs of children (age group, 6 months to 4 years) after the weaning period, the Central Food Technological Research Institute (CFTRI), Mysore, has developed a process for the preparation of weaning foods. The weaning foods developed at the institute are high protein foods and could therefore be used as a supplement to the diets of not only school children but adults also.

The process developed by the institute consists in (i) precleaning and powdering the raw materials; (ii) blending the flours obtained with other ingredients like sugar, common salt, a premix of vitamins and minerals, and amino acids, if necessary; and (iii) dispersing the blends and precooking with 4-5 times the quantity of hot water. The cooked mass is pumped on to a roller drier and the dried flakes are passed through a sieve and packed either in tins or in polythene bags.

At present there are only two firms manufacturing weaning foods in the country. Their annual production is greatly inadequate in comparison to the total requirements. The weaning foods available in the market at present are Farex (manufactured by Glaxo Laboratories) and Nestum (introduced by Nestles).

The process has been studied on a pilot plant scale. Large scale trials have also been carried out at National Diary Research Institute, Karnal.

The product has been tested by a number of tasters who have shown the preference for the weaning food developed at CFTRI as compared to a widely marketed product.

Edible grade groundnut flour, Bengal gram, green gram, maida, sugar, calcium, iron, vitamins and salt are the main raw materials required for the manufacture of the weaning food. All these are available indigenously.

All the items of plant and equipment, except the double drum drier, required can be procured from indigenous sources.

The total capital outlay for a plant capable of producing 3 tonnes of weaning food per day has been estimated at Rs 12.55 lakh, comprising Rs 2.00 lakh for land and buildings, Rs 8.75 lakh for plant and machinery, and Rs 1.80 lakh as working capital.

Further particulars may be obtained from : The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

Destruction of Aflatoxin in Food Materials

Groundnut products are often contaminated with a toxin known as aflatoxin. It is therefore essential that groundnut meal, or protein isolate made from groundnut meal, be free of aflatoxin. A number of firms are using groundnut products without detoxification and this is a serious public health hazard.

To render the groundnut products safe for consumption, and to remove nutty odour and give attractive colour to the products, the Central Food Technological Research Institute (CFTRI), Mysore has developed a process of detoxification of aflatoxin-contaminated groundnut products. Aflatoxin-free, deodorized groundnut meal or protein possessing good dispersability in water and an attractive colour can be prepared by this process. The product can be used as a source of toxin-free protein in any food formulation or for direct consumption, and also to raise the protein content of a variety of foods like biscuits, weaning foods, and ice-cream mixes.

The process consists in preparing a suspension of groundnut meal in an alkaline medium, mixing it with a suitable oxidizing agent (such as permanganate, hydrogen peroxide, or potassium chlorate) and heating the mixture. The mixture is cooled, the excess oxidizing agent is removed, and the product is dried and packed. The process has been studied on a pilot plant (capacity, 300-500 litres of protein liquor per batch).

The institute has also used the process for producing vegetable toned milk on a pilot plant of 1000 litres capacity. The product was tested and found to conform to the permissible aflatoxin limit of 30 μg/kg, as recommended by the Protein Advisory Group of WHO/UNICEF.

Besides the main raw material groundnut meal, other chemicals and biologicals (oxidizing agent, sulphuric acid, caustic soda, indicators, and enzyme catalase) required are available indigenously.

As the process will be ancillary to an existing food industry, additional equipment required are : stainless steel holding tanks, plate heat exchangers, temperature and pH measuring and controlling instruments, stirrers and pumps. All the items of equipment are available indigenously. The additional space required for housing this equipment will be about 400 ft^2.

The total cost of a plant for detoxifying 10-20 thousand litres per day has been estimated at Rs 1.0 lakh (Rs 0.6 lakh on plant and machinery and Rs 0.4 lakh as working capital), presuming that facilities like boiler and chilled water supply are available with the entrepreneur. The estimate of investment does not include the cost of the additional space. The cost of detoxification comes to 2-3 paise per litre of liquor.

Further particulars may be obtained from : The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

Solar Stills for Obtaining Good Quality Water

Supply of distilled water in outstation laboratories is many a time beset with problems. In electrically operated distillation units the coil often requires replacement, and ion-exchange units require careful regeneration of resins for which chemicals are required. The distilled water obtained by these methods fails to meet the required standards.

Solar still experimental unit placed on terrace: CSMRI, Bhavnagar

Petrol filling stations situated especially on the highways and far away from cities also face the problem of supplying distilled water to the customers. There is considerable need therefore for simple and reliable units for producing distilled water.

The Central Salt & Marine Chemicals Research Institute (CSMCRI), Bhavnagar, has designed and fabricated a solar still for producing good quality water. Water to be distilled is placed in black bottom trays covered with inclined glass sheets to form an airtight enclosure. Solar energy heats the water and the vapours formed condense underneath the glass. The condensate flows into channels provided for this purpose.

The institute had installed ten stills, with complete concrete construction and having a total capacity of 1000 litres/day, at its salt works in 1965. The stills have functioned satisfactorily over a period of three years. One of the stills is available for demonstration to prospective entrepreneurs.

Solar stills developed by this laboratory do not require any major equipment except for a feeding pump. Construction being of civil engineering type, all the materials of construction like concrete pipes, channels, plastics and glass are available indigenously. The laboratory has installed solar stills with complete concrete constructions at Navinar lighthouse (capacity, 130 litres of drinking water per day) and at Baroda in 1968 (capacity, 80 litres of distilled water per day).

The maximum capacity of an individual plant is likely to be limited to about 22·5 m^3/day (5000 gal/day) of good quality water. A standard unit of size 2·44 × 1·22 m has a capacity of about 7 litres/day. Such units with slight changes can be placed on terraces or on ground with some masonry work. Such units have been supplied to interested parties and are functioning satisfactorily.

A unit of about 7 litres/day capacity which is made with complete wooden framework and which could be kept at any place receiving continuous sunshine costs about Rs 350. The black plastic liner costing about Rs 4 lasts about a year, provided no pinholes develop. Assuming a life of about three years the annual recovering cost with depreciation and maintenance is about Rs 150, and if a unit operates for 300 days, the cost of distilled water would be about 7 paise/litre.

Further particulars may be obtained from: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

CSIR SUPPORT TO RESEARCH

Completed Schemes

Theoretical Studies on Langmuir Films

Theoretical studies on the dielectric characteristics and optical properties of 'built-up' Langmuir films have become important because these films are of potential importance for the development of dielectric devices like high capacitances, tunnelling and 'hot' electron devices. They hold promise in the development of optical devices like interference filters, polaroids, and anti-reflection coatings. Theoretical calculations of dielectric and optical parameters of such 'built-up' films of long chain compounds like barium stearate and palmitate have been made by Miss Usha Khanna, a CSIR research fellow at the Department of Physics of the Roorkee University, Roorkee. Values of static dielectric constant and refractive index of 'built-up' films of barium stearate, palmitate, margarate and behnate calculated theoretically compare favourably with the experimental values.

The thickness of the film, which plays a crucial role in the determination of dielectric constant and refractive index, was very accurately determined for films deposited using the well-known Blodgett and Langmuir technique. The capacitance was measured using a universal bridge at 1 kc/s, and the variation of the dielectric constant of thin film was studied as a function of thickness. The film capacitors were formed by thermal evaporation of aluminium electrodes on cleaned, smooth glass slides before and after film deposition so as to form a a sandwich of the type Al-film-Al.

The studies were made under the supervision of Dr V. K. Srivastava of the Physics Department of the University. During the tenure of her fellowship, Miss Khanna collaborated in the design of a precision electrode system, which is being fabricated at the Central Scientific Instruments Organization, Chandigarh.

Dielectric Behaviour of Thin Films

Interest in dielectric breakdown studies of insulating films is rapidly increasing because of their varied applications in modern electronics technology. The 'built-up' films of a few long chain compounds, such as stearates, have been found to be promising for making dielectric devices. Breakdown characteristics of such 'built-up' films of barium stearate, palmitate, etc. have been studied by Shri V. K. Agarwal, a CSIR research fellow, who worked at the Department of Physics, Roorkee University, Roorkee (November 1968 to December 1971) under the guidance of Dr V. K. Srivastava of the Department. The breakdown strength of the film depends on the thickness of the film. The films studied are ideally suited for such studies because their thicknesses are controllable, uniform and are very accurately known. In addition, these films are easily reproducible, smooth and possess a high dielectric strength.

A systematic study of dc breakdown characteristics of barium stearate films has been made. Observations made on the voltage for onset of breakdown and maximum voltage for complete breakdown at different thicknesses of the films indicate that barium stearate has the highest resistance to breakdown. The ultimate dielectric strength of the film and the permissible limit of operating voltages, which is sufficiently high compared to onset breakdown strength, have also been determined. The 'built-up' films were deposited by the well-known technique of Blodgett and Langmuir on cleaned glass slides. This technique is such that a layer is transferred every time onto the glass slide on dipping and withdrawal, thus forming a layered structure of the films.

The ac breakdown strength of barium stearate has also been studied as a function of thickness and frequency.

New Schemes

Investigations on Industrial Uses of *Tephrosia purpurea* Seed Gum

Tephrosia purpurea (Hindi: Sarphanka) is an annual herb which grows profusely in the arid zones of Rajasthan after monsoon. The plant is valued as a febrifuge, cholagogue and diuretic in the indigenous system of medicine. The seed gum can be extracted by boiling the seeds with water followed by alcoholic precipitation. The plant is akin to the *guar* (*Cyamopsis tetragonoloba*) plant, and it is possible that the *T. purpurea* seed gum has some characteristics of *guar* gum which is a very valuable industrial gum. Under a new CSIR research scheme granted to him, Dr B. M. Mithal (principal investigator) of the Department of Pharmacy, Birla Institute of Technology & Science, Pilani, proposes to study the properties of the seed gum of *T. purpurea* and explore the possibilities of its use in pharmaceutical and other industries.

Total Synthesis of Modified Steroids and Heterosteroids and their Structure-Action Relationship

The object of a new CSIR research scheme granted to Dr D. Nasipuri (principal investigator) of the Department of Chemistry, Indian Institute of Technology, Kharagpur, is to achieve total and industrial synthesis of a variety of steroidal compounds with normal as well as modified skeletons and, in many cases, with hetero atoms in the structure which are expected to bestow many important physiological properties to the compounds.

Investigation on Chromite Deposits Associated with Ultrabasic Rocks of Cuttack and Dhenkanal Districts

Extensive deposits of chromite ores occur in association with ultrabasic and basic rocks in the Cuttack and Dhenkanal districts of Orissa. The Saruabil-Maruabil chromite belt in the Cuttack district extends for about 15 miles in a NE-SW direction. In the Dhenkanal district considerable quantities of chromite ore are present near Mathkargola and Bhuban. In the first area the chromite is associated with the altered peridotite and occurs as distinct layers, whereas in the latter areas chromite occurs in olivine gabbro, and silicified ultrabasics and laterites. Chromite bearing ultrabasics in the Cuttack district are intrusive into the rocks of the iron ore series, and have been folded along with them. But the chromite in the Dhenkanal district is restricted to the gabbroic rocks which have intruded the rock series of the Eastern Ghat Orogenic Belt. The geochronology of the chromite bearing basic-ultrabasic rocks in different tectonic set-ups of the Peninsular India, their mode of emplacement and the origin of the chromite ores, are problems yet to be solved. Besides, the growing demand for this raw material for manufacturing special steels and refractories calls for detailed fundamental as well as applied investigations. A new CSIR research scheme with this objective has been granted to Dr K. L. Chakraborty (principal investigator) of the Department of Geological Sciences, Jadavpur University, Calcutta.

Studies on Indigenous Medicinal Plants

Under a new CSIR research scheme granted to Prof. S. S. Parmar (principal investigator) of the Department of Pharmacology and Therapeutics, K. G. Medical College, Lucknow, it is proposed to isolate, characterize and study the pharmacological properties of active principles from indigenous medicinal plants. To begin with, the following six plants will be investigated: *Bauhinia variegata*, *Calotropis procera*, *Capparis decidua*, *Calophyllum inophyllum*, *Flacourtia indica*, and *Tiliacora acuminata*.

Search for Earliest Hominoids in Siwalik Hills

A research programme on the development of quarriable sites for earliest hominoids in the Siwalik hills in North India was conducted at the Department of Anthropology, Panjab University, Chandigarh, in collaboration with the Division of Vertebrate Palaeontology, Yale University, and a huge collection of vertebrate fossils, including primates, was made. The fossil sites yielded rich fauna including one of the most important fossil primates, namely *Gigantopithecus*, which was widely acclaimed all over the world. The extent and nature of the collections made by the Department of Anthropology needs to be worked out and reviewed. Earlier collections had established the presence of an early man-like form *Ramapithecus* about 14 million years ago in Siwaliks. The recent discovery, by Dr S. R. K. Chopra and coworkers of the Anthropology Department of the Panjab University, of a larger and a near hominoid form *Gigantopithecus* belonging to the middle Pliocene establishes the presence in this area of a varied primate fauna and provides significant information on the stages through which the evolution of man's ancestors has progressed from ape-like forms. It is, therefore, most important that some of these productive sites be worked out to recover better and more fossil materials. Under a new CSIR research scheme granted to him, Dr Chopra proposes to continue the studies.

Gas-phase Separation of Zirconium from Hafnium

Naturally occurring zirconium compounds invariably contain small amounts (0.5-2%) of hafnium. For use as a nuclear material, zirconium should not contain more than a few parts per million of hafnium. Various techniques such as fractional crystallization of their compounds, vapour phase dechlorination, fractional distillation of their compounds, ion-exchange processes, solvent extraction, selective adsorption on silica gel, chromatographic separation, and preferential bacterial leaching have been developed for the separation of the two elements. Of these, the most widely used methods are solvent extraction and ion-exchange techniques. These methods, however, are not simple and have inherent limitations. Preliminary experiments carried out at the University of Toronto have indicated that the thermodynamics of the reactions of $ZrCl_4$ and $HfCl_4$ gas with alkali halide vapours (to form hexachloro compounds) differ appreciably. No systematic studies have been made regarding the thermodynamic and kinetic aspects of these reactions which offer excellent possibility for a stepwise gas-phase separation of zirconium and hafnium compounds. In a new CSIR research scheme, granted jointly to Dr H. S. Ray (principal investigator) and Dr A. K. Jena (co-principal investigator) at the Department of Metallurgical Engineering, Indian Institute of Technology, Kanpur, it is proposed to work out optimum conditions for maximum separation. The theoretical aspects of the gas-phase separation process would also be examined.

Metabolism of Mandelic Acid in *Aspergillus niger*

The mandelate pathway in *Pseudomonas putida* (bacterium) has been extensively investigated by various workers. Investigations made at the Department of Biochemistry, Indian Institute of Science (IISc), Bangalore, on the metabolism of mandelic acid by the fungus *Aspergillus niger* have revealed a number of significant differences in the metabolism of mandelic acid by bacteria vis-a-vis the fungus.

Under a new CSIR research scheme granted jointly to Prof. C. S. Vaidyanathan (principal investigator) and Dr P. V. Subba Rao (co-principal investigator) of the Department of Biochemistry, IISc, Bangalore, it is proposed to study in detail the metabolism of mandelic acid in *A. niger*. The pathway for the degradation of mandelic acid will be established using labelled compounds. The individual enzymes in the pathway, viz. D-(−)- and L-(+)-mandelate dehydrogenases, benzoylformate decarboxylase, benzaldehyde dehydrogenases, benzoate and *p*-hydroxybenzoate hydroxylases as well as protocatechuate oxygenase, will be isolated, purified and their properties studied in detail.

The regulation of the mandelate pathway in the fungus has not been well understood. In view of the differences in the mandelate pathways in bacteria and the fungus *A. niger*, it is reasonable to accept differences in the mode of regulation of the pathway in bacteria in comparison with the mode of regulation of the pathway in fungi. Hence, attempts will be made to identify the various factors involved in the regulation of mandelate pathway in *A. niger*.

PATENTS ACCEPTED

Indian Pat. 129079

Improvements in or relating to the preparation of iron powder

S. K. Ray & S. N. Sinha
NML, Jamshedpur

This invention covered by the patent relates to a process for the production of iron in the form of powder directly on cathodic surface by the passage of current at a particular *p*H of the electrolyte. The electrodeposited iron powder is of high purity (> 99%) and suitable for powder metallurgy and sintering purposes.

In the conventional electrolytic method, metallic iron is electrodeposited at high current density on cathode as a brittle mass, which is then powdered mechanically to a fine state of division. In this case also, electrodeposited iron is pure but requires an additional operation, that of grinding.

In the process covered by this patent, iron in the solution from which the powder is electrodeposited is maintained substantially in the form of ferrous iron with addition agents. Mild steel anodes are used on both sides of the cathode and the operative conditions and the composition of the electrolyte are so adjusted that iron is deposited directly in the form of powder that requires no grinding. Powders are collected by brushing and processed against oxidation and for preservation.

Indian Pat. 128101

A process for the manufacture of cationic synthetic tanning material (Syntan CCN)

V. S. Sundara Rao, K. K. Reddy,
K. T. Sarkar & Y. Nayudamma
CLRI, Madras

This patented process describes the development of a cationic synthetic tanning material, named Syntan CCN, from catechol-cut obtained as a byproduct from Neyveli Lignite Corporation (NLC), Tamil Nadu. This 'cut' contains about 40% catechol and 40% of its homologues. The syntan is prepared by the reaction of catechol-cut with ammonium chloride and formaldehyde in a stainless steel vessel. Being a single-step reaction, the preparation of Syntan CCN takes just about 4½ hr. All the raw materials required for the manfacture of this synthetic tanning agent, besides the catechol-rich cut from NLC, are indigenously available. Noteworthy features of Syntan CCN are that : (i) it can be used in the production of leathers either as an independent tanning material or as a pretanning/retanning agent or for sandwich tanning ; (ii) it gives good results in the dyeing of black suede leathers; and (iii) as it does not contain sulphonic acid groups, the affinity of the leather for anionic dyes is improved.

Indian Pat. 129036

A continuous fluid-bed reactor for gas-solid reactions

M. Ramacharyulu *et al.*

RRL, Hyderabad

This patent deals with the process equipment pertaining to the design of a continuous fluid-bed reactor meant for drying or carbonization of coal or lignite, for steam-activation of carbon and also for drying and roasting of solids like limestone and iron ore at elevated temperatures. Maintenance of uniform temperatures in the fluid-bed and prevention of clinkering at the gas distributor, when the preheated air or hot gases containing oxygen are used as the fluidizing media, are the salient features. Also, the fluid-bed reactor is equipped with an internal gas-solids separator for improving the quality of fluidization.

The fluid-bed reactor, designed, fabricated and installed at the Regional Research Laboratory, Hyderabad, is essentially made of mild steel, inside being lined with bricks. It has a screw conveyor and an aerated inclined pipe for feeding solids, a perforated conical distributor having a wind-box surrounding the cone for preheated air or gas entry. The solids are maintained in the form of a turbulent fluidized bed. The solid product while hot overflows into a product hopper where it is cooled with steam when necessary. The hot gases are disengaged partly of dusty solids above the fluid bed and to a great extent in the gas-solids separator having the dipleg, through which the fine solids fall back into the bed.

It is the feature of the design that, for proper fluidization, the distributor pressure drop should be 25-40% of the total pressure drop across the fluid bed which has been designed accordingly.

The fluid-bed reactor has been continuously operated for the carbonization of non-coking coals of 0.1-1.1 mm size for the production of smokeless, low volatile char using air preheated to 400-500°C as the fluidizing medium. The bed temperatures are maintained between 400 and 650°C depending on the requirements of the product and the fluidization velocities are kept between 20 and 60 cm/s. The operability of the unit is smooth and no process troubles have been experienced during several runs lasting 24-48 hr.

Indian Pat. 126120

A fluidized-bed reactor assembly for carrying out reactions involving solids and gases

K. Seshacharyulu *et al.*

RRL, Hyderabad

Reactions carried out in a fluidized-bed reactor have distinct advantages such as uniformity of temperature in the reaction zone and thorough mixing of reactants due to high turbulence. In the conventional fixed-bed reactors the reactions are generally slow due either to non-uniform temperature conditions or inefficient mixing of reactants.

The reactor assembly, covered by the patent, includes a fluid-bed reactor in which reactions between solids and fluids can be carried out with the advantages mentioned above. The temperature of the reactants is nearly uniform, and a high capacity of reactor and a uniform quality of product can be achieved.

The equipment consists of: a refractory-lined vertical chamber—the reactor — for holding the reactants in a fluidized state; a distributor for admitting fluidizing gases which are also used in the reaction; arrangement for feeding the solids, and for collecting the products; a chamber for mixing hot gases and steam; cyclone separators for collecting solids escaping from the top of the reactor; an arrangement for recovery of the waste heat from flue gases; and a furnace.

The solids fed get preheated in the upper part of the reactor or in the reaction zone before the actual reaction commences. Gaseous feed is preheated in the superheating chamber by the outgoing gases. The reactor can be operated either batchwise or continuously.

A plant for the production of activated carbon using the reactor assembly has been designed, fabricated and operated at the laboratory.

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Petroleum Specialty Products : Seminar at IIP

At a seminar on Petroleum Specialty Products held at the Indian Institute of Petroleum (IIP), Dehra Dun, on 19-20 May 1972, nineteen papers dealing with transformer oils, white oils, liquid paraffin, petroleum sulphonates, spray oils, rubber processing oils, quenching oils, watch and clock oils, rust preventives and waxes were discussed. Some 108 delegates, including 58 from IIP, participated in the seminar which was divided into five sessions.

In his key note paper 'Petroleum specialty products in India', M. G. Krishna (Director, IIP) highlighted some policy issues, viz. development of a system to collect reliable statistics on petroleum specialties in regard to their production, sale and uses; an effective system for quality control and inspection of products; constant review and development in process technology for various stocks likely to be processed in India; review of specifications in the light of the national context and needs; and market-oriented and interdisciplinary R & D efforts to assist the manufacture and application of these products.

Session I

Data obtained from four commercial units (combined capacity 30 000 tonnes/year) along with laboratory data have been analyzed in order to develop the kinetic and scale-up parameters for the entire range of hydrocarbon oils from petroleum ether to high viscosity oils, according to the paper 'Some aspects of specialty oil manufacture' by M. C. Dwivedi of the Department of Chemical Engineering, IIT, Bombay. Providing guidelines for the selection of suitable base stocks, the paper dealt with the application of batch process data for working out a continuous process as well as the scale-up criteria.

In their paper 'Transformer oils: physico-chemical and electrical properties', K. S. Anand, S. K. Chhibber, B. R. Chadha and P. K. Goel (IIP) discussed the influence of viscosity index, sulphur and pour point on electrical properties. It was found that resistivity and power factor of transformer oils improved with increase in viscosity index and pour point. The resistivity of transformer oils increased when the sulphur content of base stocks was lowered by severe hydrotreatment but the power factor decreased. It was also observed that the degree of improvement in electrical properties was not commensurate with reduction in sulphur when a low-sulphur high-viscosity oil was blended with a high-sulphur low-resistivity oil.

Insulating oils used as dielectric and coolant media in electrical equipment were being imported till 1970. The oils conformed to BS : 148 (1959) in which the maximum permissible pour point was of the order of −30°C. Such low ambient temperatures are unlikely to occur in India and therefore the Indian specification (IS : 335) was amended in 1965 to raise the pour point up to −10°C. T. D. Gupta and J. R. Nanda described the experimental work conduced at Central Power Research Institute, Bangalore, to determine the relationships between various insulating oil characteristics, such as pour point, viscosity, specific resistance and loss tangent, and to analyze the parameters involved in refining for the production of good quality oils. The authors conclude that the production of electrically suitable insulating oils from indigenous feedstocks must essentially make use of base stock hydrofining, a process which increases the naphthenic content and lowers the viscosity index. Oils produced in this manner are similar to imported oils except for pour point, which assumes secondary importance in view of the country's climatic conditions. Also, it is concluded that IS : 335 (1963), revised and amended in its present form, is quite a stringent specification and does not need further revision.

Session II

The process developed at IIP for the production of liquid paraffin and sulphonates from indigenous base stocks was described by B. R. Chadha, S. K. Chibber, K. S. Anand and P. K. Goel along with the properties of the products as mentioned in various international specifications.

In the paper 'Spray oil for rubber plantation' by K. Sitharama Rao, R. B. Chore and George John (Indian Oil Corporation Ltd) mention was made of the abnormal leaf fall due to fungus attack in Kerala rubber plantations. Spraying resulted in leaf retention and hence higher yield of rubber. Till recently such oils were imported. Indian Oil Corporation Ltd, in collaboration with Rubber Research Institute, Kottayam (Kerala), conducted extensive trials on the indigenous oil developed by IOC during 1970-71. The test results were very encouraging, and the rubber plantation industry in Kerala almost exclusively used IOC spray oil 70 in 1971 with excellent results. It is expected that the demand for such oils would appreciate in future with increase in plantation activities.

Petroleum sulphonates obtained as byproduct during the manufacture of technical and medicinal white oils are used as detergent-dispersant additives in motor oils, as emulsifiers in the formulation of soluble oils, and as rust and corrosion inhibitors. In the paper 'Oil soluble metallic petroleum sulphonates' by O. N. Anand, V. P. Malik and P. K. Goel (IIP), the effect of the ratio of the oil to the sulphonating agent on the yield and average molecular weight of the sodium petroleum sulphonates prepared at IIP was discussed.

Session III

Efforts towards the development of indigenous know-how and import substitution in the area of petroleum specialties during the last 20 years were reviewed by J. S. Shah (Petrochem Industries and Mosil Lubricants).

Information in respect of the supply and demand, manufacturing processes, quality control and application of transformer oils, white mineral oils, liquid paraffins, petroleum jellies, cutting oils, etc. was given by B. Lalitha, K. S. Anand and H. K. Mulchandani of IIP.

In his paper 'Petroleum specialty products and their standardization', M. A. U. Khan of the Indian Standards Institution pointed out the broad correspondence between IS specifications and overseas specifications for these products and pinpointed the areas where standardization would play an effective role in future for the development of better products.

The paper 'Specifications for petroleum specialty products : Indian realities' by P. Desikan (Nagpal Ambadi Petrochem Refining Ltd, Madras) described the significance of some of the specifications for these products in terms of their application and speculated on the need for, or possibility of, relaxing or tightening the specification requirements with special reference to Indian conditions.

Session IV

Rubber oils are classified as aromatic, naphthenic or paraffinic. The demand in regard to aromatic oils is met by imports, while the other two varieties are available to a large extent indigenously. These are used in the processing of rubber goods from natural, synthetic or reclaimed rubber, manufacture of oil extended rubber, manufacture of reclaimed rubber and as a secondary plasticizer in the manufacture of PVC-leather cloth. D. R. Bhide (Esso Eastern Inc., India Division) described the physico-chemical characteristics of these oils on which are dependent their performance and end use.

Quenching oils are used to provide adequate hardness and to reduce stresses in metals. A. K. Mehta, N. Suresh and P. K. Goel (IIP) described the metallurgical aspects of quenching of steels and various methods used for assessing hardening power and cooling abilities of quenching media. A rig fabricated at IIP, Dehra Dun, for assessing cooling powers of different media was also described.

The paper 'Lubricating oils for special and delicate machinery' (P.V. Krishna; RRL, Jorhat) dealt with the classification, general specifications and characteristics of lubricants for use on delicate machinery and the possibilities of producing them indigenously.

Standard watch and clock oils are still imported into India and these are either proprietary in nature or patented. The important characteristics of these oils are non-spreading tendency, oxidation stability, low volatility, low pour point, anticorrosiveness and adequate film strength. Attempts made at Defence Research Laboratory (Materials), Kanpur, on the production of these oils were described by A. K. Misra and coworkers. Complex esters based on glycols, acids and alcohols have been synthesized and the functional characteristics of various groups present in these have been determined in order to correlate them with those of watch and clock oils.

The paint industry's requirements of aromatic solvents are substantially met by imports. Experiments carried out at IIP on thermal reforming, with steam, of light iomex from Barauni Refinery were dealt with by J. S. Bawa and coworkers. Thermal reforming of iomex with steam was found to give a product (73-77% yield) containing more than 90% aromatics. The liquid product meets the specifications of aromatic solvents.

Session V

Rust preventives comprise a wide range of materials, viz. metallic coatings, lacquers and paints, oxides and chemically formed films, and petroleum based products. Petroleum rust preventives are cheaper and can be more easily applied than others. The investigations made by Esso Eastern Inc., Bombay, on indigenous manufacture and marketing of these items were dealt with by S. P. Sarma.

The demand for microcrystalline waxes used by cosmetics, pharmaceuticals, paint and other industries in India is estimated at 3000 tonnes/annum. The results of studies on the production of microcrystalline waxes from indigenous sources formed the subject of a paper read by Y. Kumar and coworkers (IIP). It was found that for the manufacture of high melting microcrystalline waxes (type C), Gujarat tank bottoms are the most economic and potential source, whereas for the production of flexible variety (types A & B), residual slack waxes, which would be available from Haldia Refinery, are the most suitable.

Studies carried out at IIP in collaboration with the French Institute of Petroleum, France, on colour improvement, colour stability and removal of sulphur compounds from waxes by hydrofinishing process were described by K. M. Murad *et al.* of IIP. Hydrofinishing has distinct advantages over clay and acid treatment in the production of finished waxes; by the use of a highly active catalyst, a good quality product passing the US Food and Drug Administration test was obtained.

De-ashing of Graphite by Chemical Reactions : CFRI

The process for de-ashing of natural or beneficiated graphite (Indian Pat. 130442, 131020 & 134546) developed by the Central Fuel Research Institute (CFRI), Dhanbad, it has been found on further studies, could de-ash graphite with low ash (1%) to a graphite content of 0.05%. Such low ash graphite is required for making special types of carbon brushes and in electro metallurgical industry. The novelty of the process lies in avoiding the use of strong acids and alkalies in the fused state, as is done in the existing process.

The advantages of the new process are that it prevents the corrosion of the costly nickel or nickel alloy container and reduces the consumption of chemicals. Also, such drawbacks of the existing processes as (i) recourse to high temperature and its stringent maintenance, (ii) continuous agitation, and (iii) special equipment to avoid the attack of chemicals both on the fused sample and container are overcome.

The process consists of the following steps : Finely ground graphite is mixed with alkali in aqueous solution and the paste is dried to reduce moisture content to around 0.5%. The dried paste is crushed to powder and is evenly spread on a metallic container. After heating the container at about 700°C in a furnace, the powder is washed with hot water to free it from alkali followed by acid treatment with excess acid. The product is again heated up to 100°C with a strong acid for some time. The powder is washed to render it acid-free and is dried.

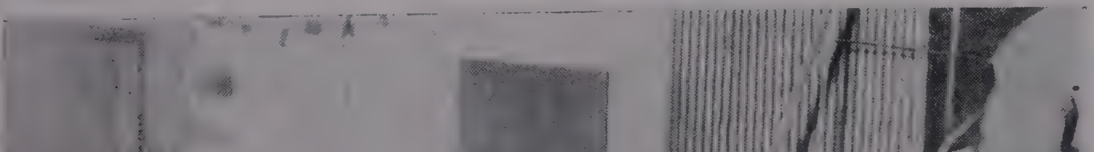
Graphite samples with 15, 8.5 and 1.0% ash were de-ashed using the new procedure. The ash content after de-ashing was found to be 0.3, 0.2 and 0.05% respectively.

PROCESSES & PRODUCTS READY FOR COMMERCIAL UTILIZATION

Automatic Reel type Cutting Table used in Brick Manufacture

Cutting tables are important items of equipment in the manufacture of wire-cut bricks. These are used to cut an extruded column of clay from an extrusion machine into bricks or other units. A number of mechanized plants have been set in the country using imported machines including cutters. The Central Building Research Institute, Roorkee, has also developed a brick-making machine capable of producing 3000 bricks per hour.

An automatic cutting table has been developed by the institute. It comprises a chassis which provides the base for a reel assembly with clay column and the reel assembly has three sets of cutting wires fixed at 120° each to cut the clay column into bricks in a rotating motion. A measuring belt, which is moved by the pressure of the clay column, transmits the linear velocity of the clay column to reel-rotating and reel-reciprocating mechanisms. The novel features of the cutting table are that: (i) it is suitable for producing up to 6000 bricks/hr; (ii) it consists of four sub-assemblies, viz. reel-rotating mechanism, reel-reciprocating mechanism, reel, and measuring belt; and (iii) reel-rotating and reel-reciprocating mechanisms have been provided with independent drives.



Automatic reel type cutting table used in brick manufacture: CBRI, Roorkee

At present there is no indigenous production of such machines and the entire requirements are met through import. However no reliable data regarding the demand are available. It is anticipated that with the availability of the indigenous machine, the demand will be considerable.

Mild steel structural elements, high carbon steel components, gun-metal bushes, cast iron castings, standard ball bearings, and brake lining are the main components required. All are available indigenously.

A full size prototype machine designed and fabricated at the institute is giving satisfactory service.

The cost of production has been estimated at Rs 10 000 a piece.

Further particulars may be obtained from: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

Low-cost Solar Water Heater

A solar water heater of 90 litres capacity comprising a flat, shallow tank, which performs the dual functions of absorbing heat and storing the heated water, has been designed, fabricated and tested by the Central Building Research Institute, Roorkee. Test results at Roorkee show that 90 litres of hot water at a mean temperature of 50°C could be run off at 4 pm in the month of January.

The heater is ideal for daytime use and can store hot water overnight provided it is covered with some insulation during night-time.

It consists of a galvanized-iron rectangular tank of 20 gauge of 112×80×10 cm size and of about 90 litres capacity. This is placed in a mild steel sheet (20 gauge) tray with glass (3 mm) on the front side and having a layer (5.0 cm) of fibre-glass insulation on the back and sides. Two angle-iron stiffners are used on the front side of the tank which are then bolted to the sides of the tray. The front face of the tank is blackened with lampblack paint after treatment with a suitable primer. The flow of hot water from the outlet is controlled by means of a gate valve fixed at some convenient place in the inlet pipe.

The whole assembly is oriented due south and inclined at 45° from the horizontal with the help of a built-in stand or some other suitable wooden or masonry stand.

The heater can be manufactured easily from local materials and the only skill required is that of a sheet metal worker. The manufacturing cost of a unit is estimated at Rs 220.

Further details of the solar water heater can be obtained from: The Director, Central Building Research Institute, Roorkee.

Glazing Lacquer

This is a glazable nitrocellulose lacquer which imparts a high gloss to finished lizard skins and morocco leathers. The lacquer also imparts water resistance to the finish unlike the protein finishes which are being used at present.

As the leathers are being exported mainly in the unfinished form, the demand for the glazing lacquer is not considerable (5-10 tonnes/annum). However, it is expected that tanners would take up finishing of reptile leathers, and as a consequence the demand for this product is expected to go up.

The Central Leather Research Institute, Madras, has developed a process for the manufacture of glazng lacquer (R). The process has been studied on a pilot plant scale and the product has been successfully ried at the institute's pilot tannery.

The process is simple and will be more economical if it is taken up as an adjunct to the production of lacquers and lacquer emulsions. The ecommended capacity of a glazing acquer producing unit is 10 tonnes/nnum.

Stainless steel vessels, wooden and paddles, and stirrers are the main items of equipment required. All are available indigenously.

Nitrocellulose and solvents are he main raw materials needed. Nitrocellulose will have to be imported (1 tonne/annum).

For a plant capable of producg about 30 kg of glazing lacquer er day the capital investment is timated at Rs 25 000, and the cost f production at Rs 9.00/kg.

Further particulars may be obtained from: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

Violin Gut

Violin gut is prepared from sheep and goat intestines and is being imported into the country. At the instance of the Centre for the Development of Musical Instruments (CDMI), Madras, the Central Leather Research Institute (CLRI), Madras, undertook the development of a process for producing violin gut. The demand for violin gut is said to be considerable, though no statistics are available.

Various aspects of cleaning the intestines and making them into cords suited for tropical conditions were studied on a laboratory scale. The samples produced at the institute were comperhensively tested by CDMI and found satisfactory in all respects.

The process developed by CLRI is simple and involves the use of indigenous chemicals and of equipment which can be fabricated indigenously.

The main raw material required is the small intestine of sheep and goat. Small calibre casings, which do not find ready market for the production of sausage casings, can be used for this purpose.

As the guts are used in expensive musical instruments, a good price could be expected for them. When the process is commercialized, it will not only eliminate the import of violin guts but the product could find a market in South East Asian countries.

Further particulars may be obtained from: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

Violin Bow Hair

Horse tail hair, white or offwhite in shade, is generally used in the violin bow, and this material is presently imported, as the horse tail hair available in the country is mostly black or brown. The Central Leather Research Institute (CLRI), Madras, has developed a process for cleaning, scouring and bleaching such hair, which does not presently find any valuable use in India, to white or offwhite shades without producing any detrimental effects on the hair strength.

Various aspects of the process, such as cleaning, scouring and bleaching of the horse tail hair, have been studied on a laboratory scale. The samples of violin bow hair processed in the laboratory have been comprehensively tested by the Centre for Development of Musical Instruments (CDMI), Madras, for use in violin bows and found satisfactory in all respects. The demand for violin bow hair is said to be considerable, although no reliable data are available.

The main raw material required is the horse tail hair having a length of 65 cm and above. Besides this, the chemicals required are available indigenously. Simple glass or enamel trays are the main items of equipment required in the process. A unit capable of bleaching about 2 kg of horse tail hair per day would be economical.

A good price is expected to be realized for the processed hair. Once the process is commercialized, it will not only eliminate the imports of violin bow hair but the material could be exported to South East Asian countries.

Further particulars may be obtained from: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

CSIR SUPPORT TO RESEARCH

Completed Schemes

Ferroelectrics and Related Crystals

Studies on the thermal expansion of some ferroelectric and related crystals have been carried out by Shri H. V. Tiwary, a CSIR research fellow, working under the supervision of Prof. P. S. Narayanan at the Department of Physics, Indian Institute of Science, Bangalore. Optically transparent single crystals of the following substances were grown from aqueous solutions: calcium strontium propionate (I); calcium lead propionate (II); calcium barium propionate (III); potassium trihydrogen selenite

(IV); and ferric ammonium sulphate dodecahydrate (V) and its deuterated variety [ND_4 Fe $(SO_4)_2.12 D_2O$] (IV).

Complete morphology of the faces of these crystals was obtained by slow evaporation at controlled temperatures and also by the reversed oscillation technique. Thermal expansion measurements covering the phase transition temperatures of the fully grown crystals have been carried out employing Fizeau's interferometric technique.

The ferroelectric transition temperature of I was found to be around +6.8°C. Also, anomalous variation in thermal expansion of the crystal was observed near −65°C and −15°C, which was attributed to peculiar piezoelectric and electrostrictive effects in these crystals.

Crystals II and III, which are tetragonal and cubic respectively, do not exhibit ferroelectricity. Two phase transitions, one around −90°C and the other around +55°C, were detected in the case of II; and the transition temperature in the case of III was around −8°C. Both the crystals were found to crack at the lower transition temperatures.

Measurement of thermal expansion of IV was carried out in all the three orthorhombic directions and phase transition was noticed around −62°C below which the crystal was found to contract along *a* axis. It has not been concluded whether this crystal is ferroelectric or antiferroelectric. The nature of the anomaly in the linear thermal expansion coefficient reveals the phase transition to be of second order.

The transition temperature of both the ferroelectric crystals V and VI was around −185°C, which had no damaging effect on the crystals.

Magnetic Resonance of some Hydrated Salts

An NMR spectrometer of the Pound-Knight-Watkins type working at 13.5 MHz and other accessories including the magnet current stabilizer were constructed by Shri K. Muthukrishnan, a CSIR research fellow, working under the direction of Dr J. Ramakrishna, at the Department of Physics, Indian Institute of Science, Bangalore.

A variable temperature accessory (90-400°K) suitable for studying powder and single crystal samples was also constructed. Using this apparatus, measurements were made with lithium formate monohydrate, hydrated fluorosilicates, and hydrated acid fluorides of cobalt and nickel for studying the internal molecular groups in the crystals.

Lithium formate monohydrate, an optically important piezoelectric crystal, was studied for ^1H resonance, and using the Pake method the positions of the hydrogen atoms were fixed. The effects of vibration of water molecules in the crystal and the temperature variation of the powder spectra were studied for possible phase transitions. The ^7Li resonance was also studied and the quadrupole coupling constant and the directions of the field gradient tensor were located in the single crystal.

The temperature variation of NMR spectra of powder samples of hydrated fluorosilicates was studied in the case of $ZnSiF_6 . 6H_2O$; $MgSiF_6.6H_2O$; $NiSiF_6.6H_2O$; $CoSiF_6. 6H_2O$; $CuSiF_6 . 6H_2O$; $CuSiF_6. 4H_2O$ and $MnSiF_6 . 6H_2O$ for both ^{19}F and ^1H resonances. The occurrence of molecular motion at various temperature ranges has been indicated. Studies on single crystals were made at various temperatures to ascertain the p-p direction and the axis of reorientation.

Studies on ^{19}F and ^1H resonance in hydrated acid fluorides of cobalt and nickel in the temperature range 90-400°K indicated the presence of molecular motion. The correlation frequency and potential barrier hindering the motion were calculated. Studies on single crystals were made to fix the axis of reorientation.

Other substances studied include $NiSnCl_6 . 6H_2O$, and $CuSnCl_6. 6H_2O$; the former showed phase transition whereas the latter did not.

New Schemes

Dielectric Properties of Polymers

For the development of polymeric materials required in the manufacture of insulators and capacitors a knowledge of the relation between dielectric properties and the structure of the polymers is essential. In a new CSIR research scheme sanctioned at the Department of Physics, Andhra University Postgraduate Centre, Guntur, Dr C. R. K. Murty (principal investigator) proposes to investigate (i) dipole moments, (ii) dielectric constant and its temperature variations, and (iii) dielectric dispersion of polymeric substances like poly(methyl methacrylate), poly(methyl acrylate) and poly(butyl α-chloroacrylate).

Development of a Wire type Resistance Strain Gauge without Cross-sensitivity

Electrical resistance strain gauges are widely used in research laboratories and industries. Indigenous manufacture of electrical resistance strain gauges is limited to two units at Roorkee which produce only multiple loop zigzag wire type gauges. These have been extensively replaced by foil type gauges mainly on account of the former's sensitivity to the effects of transverse strains leading to errors in the strain to be measured in the gauge direction. The foil type gauge has not yet been commercially developed indigenously and is, therefore, being imported in large quantities for use where the transverse sensitivity error is not acceptable.

A wire type gauge with thicker welded cross connections at the ends of the active gauge length, completely eliminating the transverse sensitivity errors, has been successfully developed in Switzerland. This interesting method if developed here also would be extremely useful inasmuch as it would provide a wire type strain gauge without transverse sensitivity and provide a quick and successful replacement for the imported foil type gauge. Subsequently, foil type gauges could be developed indigenously. A new CSIR research scheme with this objective has been granted to Dr Rasheeduzzafar (principal investigator) of Zakir Husain College of Engineering and Technology, Aligarh Muslim University, Aligarh.

Synthesis of Novel Fluorescent Whiteners

The objective of a new CSIR research scheme granted to Dr S. Seshadri (principal investigator) of the University Department of Chemical Engineering, Bombay, is to synthesize a large number of heterocyclic compounds in which a heterocyclic system is linked to a benzazole unit in the 2-position and to study their potentialities as optical whiteners for synthetic fibres, especially terylene. The synthetic procedures envisaged are capable of yielding new structures not accessible by conventional methods. The project is of considerable applied value not only because of the growing importance of synthetic fibres but because optical whiteners for terylene are not manufactured in India.

Design and Development of Low Speed Strain-rate Controlled Universal Testing Machine

Low speed strain-rate controlled testing machines are highly essential in certain methods of stress analysis, such as photoplasticity, and in investigations on structural creep or mechanical behaviour of high polymers. These machines are being imported at present. Indigenous design and development of such a machine would provide a useful multipurpose testing device for conducting research in the field of stress analysis, mechanical testing of polymers and fracture mechanics. In a new CSIR research scheme granted jointly to Dr R. S. Alwar (principal investigator) and Shri M. A. Parameswaran (co-principal investigator) of the Indian Institute of Technology, Madras, it is proposed to design and develop a low speed strain-rate controlled testing machine that can be used to test specimens under tension or compression at strain rates varying from as low as 2%/hr to about 10%/hr. The capacity of the machine is expected to be 10 tonnes.

Studies on Pond Ecosystems at Bhagalpur

Under the auspices of the International Biological Programme (IBP), systematic attempts have been made to study the productive capacity of different types of ecosystem. Investigations on the production of phytoplankton and its relationship with fish production in deep ponds and lakes have been pursued to a limited extent in India. The ponds of Bihar generally get infested with different types of macrophytes and gradually become shallow in course of time. The association of plants and fish as well as other types of biota is quite different in shallow waters from that of the deep ponds and lakes. Relatively little information is available on this aspect of the ecosystem together with the productive capacities of such type of ponds, and also on the nature of energy flow and circulation of minerals in a pond of such type in the eastern region of India, particularly Bihar. Under a new CSIR research scheme granted jointly to Dr J. S. Dutta Munshi (principal investigator) and Dr (Mrs) Jayashree Dutta Munshi (co-principal investigator) of the Bhagalpur University, Bhagalpur, it is proposed to carry out studies on these aspects of pond ecosystems at Bhagalpur. The investigation is expected to throw light on the physico-chemical conditions and the productive capacities of the ponds of Bhagalpur and the ways and means of improving them.

Behaviour of Dynamically Loaded Bearings

Under a new CSIR research scheme sanctioned to Dr B. K. Gupta (principal investigator) of the Department of Mechanical Engineering, Motilal Nehru Regional Engineering College, Allahabad, it is propsed to predict theoretically the performance of finite dynamically loaded bearings and to verify experimentally some of the assumptions made in theoretical analysis.

The long term goal of the scheme is to rationalize the design of dynamically loaded bearings such as the bearings of internal combustion engines, pumps, and compressors.

PATENTS ACCEPTED

Indian Pat. 129033

A process for making a substitute for Canada balsam suited for making slides of pathological specimens for microscopic examination from the crude natural resin chandrus (*Shorea weisneri*)

J. G. Srivastava
NBG, Lucknow

Canada balsam is used mainly for making permanent slides of botanical, zoological and geological specimens for microscopic examination. It is being imported at present into the country to the extent of about 2000 kg/year involving a foreign exchange of about Rs 2 lakh. More than half of Canada balsam imported is used in petrological laboratories. There is need for a special type of Canada balsam, such as the one supplied by Stafford, Allen & Co., London. This becomes very tenacious on drying so that once a slice of rock has been fixed on a slide with this, the specimen can be ground extremely thin without any risk of its getting loose and falling off from the slide during grinding.

The patented invention relates to the utilization of the crude resinous exudation chandrus (*Shorea weisneri* Schiffn., Dipterocarpaceae), commonly available in Indian markets, for making a substitute for Canada balsam that is as good as the material supplied by Stafford, Allen & Co., and can be produced very cheaply and in any quantity.

The solvent used is a mixture of *n*-hexane and solvent ether (100 : 1), which quickly extracts that part of the crude resin which is suitable for petrological work. It is very tenacious in grip so that rock specimens do not get loose and fall off the slide during the grinding process. Moreover, it completely dissolves in xylol giving a pale and clear solution with a refractive index of 1.52-1.53, which dries fast, does not get discoloured or crystallized on ageing, and does not get cloudy or cracked by the action of atmospheric moisture.

The cost of production comes to about one-tenth of the catalogue price of Stafford, Allen & Co. material. The byproducts can be suitably processed to give a high class furniture polish, superior to that given by chandrus itself.

Indian Pat. 127151

Sintered cadmium selenide photoconductive cells

C. V. Suryanarayana, N. Rangarajan, K. N. Rao & Mrs M. J. Chockalingam
CECRI, Karaikudi

The preparation of very high purity cadmium selenide powder, presently imported into the country, involves very special and expensive techniques. The invention covered by the patent relates to the development of a cheap, easy and reproducible method of preparing high purity cadmium selenide powder and sintered cadmium selenide photoconductive cells from the powder. The powder is prepared by the interaction of an aqueous solution of cadmium salt with an aqueous solution of sodium selenosulphate at *p*H 10 (optimum), obtained by adding a suitable alkali. Incorporated with dopants and fluxing material, the powder is given a bulk firing around 500° C for about 30 min.

For preparing cells, the slurry, prepared from the sensitized powder using water, is painted on an unglazed porous ceramic substrate. The layer is sintered at 500° C for 5 min. After suitable ohmic contacts have been given the cells are lacquered and encapsulated.

The cells show high photoconductivity in the region 0.4-1.4 μ with a peak at 0.75 μ and are comparable in performance with the imported ones.

The cells find use in electronic musical instruments, computers, recorders, choppers, and photoelectric circuits. They are highly useful for fast switching and counting even at very low levels of illumination. Once the cells are put into the market, the optoelectronic industry in the country is bound to find a variety of applications for them.

Indian Pat. 127269

Improvements in or relating to the manufacture of twisted waveguides and jigs therefor

J. Singh, F. Singh & R. C. Kumar
CEERI, Pilani

Twisted waveguides for microwave hardware are conventionally manufactured by electroforming (electrodeposition) to full wall thickness of the material on a resinous mould of the required shape and dimension, and melting out the mould by heating. The mould cannot be reused as it is difficult to take it out without breakage because of its twisted shape. Also, the process is slow and unsuitable for producing waveguides in numbers, as individual moulds are required for each twist.

The process covered by the patent is of considerable improvement over the method in vogue. It consists in: (i) cutting a preformed waveguide of required band to the required length of the twist; (ii) filling it with molten lead and placing in a preliminary jig to be shaped to required angle; (iii) removing the lead by heating; (iv) inserting the waveguide in a final jig; and finally (v) forcing rollers of varying sizes through the orifice of the twisted waveguide. This process leads to an accurate and highly finished twist.

Some of the major advantages of the mechanical process over the electroforming process are as follows: (i) Super-fine finish is imparted to the twist, both inside and outside. (2) The need for making high-precision individual mould is dispensed with; also, there is no need for a highly skilled technician to operate the jig. (3) Furthermore, not only is there no need for costly equipment but the cost of production is low and the rate of production high.

Indian Pat. 128130

A new process for the preparation of an enzymic product to be applied for efficient removal of unwanted proteinous matter in leather, silk and other industries

S.C. Dhar & S.M. Bose
CLRI, Madras

The invention covered by the patent relates to the development of a process for the manufacture of an enzymic product making use of dried and powdered papaya latex or commercial papain blended with sodium chloride, anhydrous sodium sulphate and boric acid. The enzymic product could be used for bating skins and hides in the *p*H range 3.0-6.5 for the production of different types of leathers, for degumming silk fibres, and for removal of gelatin from coated photographic films.

Bating of skins and hides in the alkaline *p*H range making use of pancreatic and microbial enzymes is well known. For the manufacture of certain types of leathers it is sometimes advantageous to perform the bating operation in the acidic *p*H range followed by pickling in the same bath. Although degumming of silk fibres is usually carried out by using hot concentrated soap solution, enzymic degumming of silk may also be adopted to obtain similar results. The enzymic product may be applied for the quick removal of gelatin layer from the coated photographic films for the recovery of silver.

PATENTS FILED

308/72: Improvements in or relating to a digital dampometer used in the measurement of logarithmic decrement, P. E. Sankaranarayanan & B. S. Adiga—NAL, Bangalore.

396/72: A stove suited for domestic use, A. K. Shaha—IIP, Dehra Dun.

397/72: Light intensity analogue to digital converter, S. P. Suri & M. Khuller—NPL, New Delhi.

409/72: Preparation of *Strychnos* gum, a new seed polysaccharide obtained from the seeds of *Strychnos potatorum* Linn., for use as an industrial gum, M. Ram—RRL, Jammu.

410/72: Substrate heater-cum-holder for thin film deposition, A. Singh—CEERI, Pilani.

483/72: An infrared detector, S. P. Suri & M. Khuller—NPL, New Delhi.

CSIR Society Reconstituted

The Society of the Council of Scientific & Industrial Research has been reconstituted for a period of three years with effect from 1 September 1971 to 31 August 1974, and consists of the following:

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Prime Minister

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Industrial Research
New Delhi

Symposium on Environmental Pollution

A symposium on Environmental Pollution is being organized by the Central Public Health Engineering Research Institute (CPHERI), Nagpur, in collaboration with the Indian Association for Water Pollution Control on 9-11 January 1973 at CPHERI, Nagpur. The topics to be discussed will include: (i) water pollution, (ii) water treatment, (iii) sewage treatment, (iv) industrial waste treatment, (v) air pollution control, and (vi) solid waste disposal. The last date for submission of abstracts is 30 September 1972 and of full text, 31 October 1972. Papers already published or presented at symposia/seminars are not acceptable.

Enquiries regarding the symposium may be addressed to the convener Dr G. K. Seth, CPHERI, Nagpur 17.

Seminar on Bacterial Leaching

A seminar on Bacterial Leaching will be held some time during the fourth week of December 1972 at the National Metallurgical Laboratory, Jamshedpur.

The scope of the seminar will cover: (1) Assessment of low grade deposits of non-ferrous metals such as copper, cobalt, nickel, molybdenum and uranium for their suitability for bacterial leaching; (2) Bacterial leaching as an alternative process for conventional processes of extraction; (3) Economic viability of bacterial leaching of low grade ores as compared to conventional methods; (4) Recovery of metallic values from dilute solutions with special reference to copper, using cementation, ion-exchange, and solvent extraction methods; (5) Role of bacteria in the dissolution of minerals; and (6) Isolation and identification of bacteria responsible for leaching of ores, etc.

Technical contributions are invited from metallurgists, mining engineers, microbiologists, research scientists and industrialists for discussions at the seminar. Abstracts and full papers are to reach the laboratory by 30 September and 31 October 1972 respectively.

Further information may be obtained from the organizers of the seminar, Dr Y. N. Trehan & Shri S. R. Srinivasan, National Metallurgical Laboratory, Jamshedpur 7.

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

ADVERTISEMENT NO. 18/72

It is proposed to appoint a Director to head the Central Glass & Ceramic Research Institute, Calcutta.

Job Requirements: It is a top research management post in the field of glass and ceramics. The Director is required to provide high-level leadership in the formulation of R & D programmes and projects, organizing and coordinating team work and assuring commercial utilization of the results of research. He will have the overall responsibility for the work of the institute and for creating an atmosphere conducive to creative work. The main objects of the institute are research and development in the field of glass and ceramic technology.

Qualifications/Experience: There is no standard application form prescribed as such. Candidates must provide proof of their academic level, industrial R & D experience and management ability consistent with the job requirements specified above. High academic qualifications in physics, chemistry, geology or glass or ceramic technology. Good experience of independent R & D work and guiding scientific workers in areas related to glass and ceramics; experience of production, pilot plants and factory operations desirable.

Scientists/Technologists interested may obtain a standard proforma for sending their *curriculum vitae*. They can also obtain a brochure on the aims and objects and the latest annual report of the institute.

Salary/Conditions of Service: The salary may be fixed in a scale ranging from Rs 1600 to Rs 3000 p.m. The person appointed will be on contract for a period of six years, subject to confirmation after two years of satisfactory service. Other conditions of contract will be supplied on request.

Age Limit: Below 50 years, relaxable in special cases.

All correspondence in this regard may be addressed to: Secretary, Council of Scientific & Industrial Research, Rafi Marg, New Delhi 1, and the completed *curriculum vitae* proforma must be received in this office on or before 3 October 1972.

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CSIR NEWS

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CURRENT RESEARCH PROGRAMMES : NAL

Fifty-three projects are under investigation at the National Aeronautical Laboratory (NAL), Bangalore. Of these, three are fundamental research projects and the remaining are applied research projects investigated at the instance, or on behalf, of the Hindustan Aeronautics Ltd, Defence R & D Organizations, Gas Turbine Research Establishment and Aeronautical Development Establishment. Some technical aid projects sponsored by industry are also undertaken for investigation.

A brief account of the scope and objectives of important projects in the Aerodynamics, Propulsion, and Structural Sciences divisions is given in the following paragraphs. Projects being investigated in Materials Sciences, Electronics, and Instrumentation divisions will be covered in the next issue.

Aerodynamics

4-ft Trisonic wind tunnel: Tests and analysis

The 4-ft trisonic wind tunnel is the only major aerodynamic facility in India in which aerodynamic testing for development of flight vehicles can be done. Hence it is used to a great extent for obtaining aerodynamic data on specific configurations of models of flight vehicles being designed and developed by Hindustan Aeronautics Ltd (HAL), Defence Research & Development Organizations and Space Science & Technology Centre (SSTC). A number of tests on aircraft configurations for HAL, on bombs and projectiles for Defence, and on launching rocket models for SSTC are conducted and results provided to them. The demand for the use of the tunnel by these organizations is continuously increasing. Apart from using the tunnel for generating aerodynamic data on specific configurations, it is planned to use it for developmental research such as the study of airframe-exhaust jet interaction, development of intakes for supersonic aircrafts, and development of supercritical wings.

1-ft Trisonic wind tunnel: Research and development

This facility is most suited for undertaking applied research programmes. Because of the small size, it is used only to a limited extent to generate aerodynamic data on specific configurations. Experimental investigations relating to the various projects such as shock wave boundary layer interaction with suction, investigations on base flows, dynamic stability tests, flutter model tests, and air intake studies are planned.

Analytical definition of aircraft shapes and flow field determination

It is sought to define the aircraft shape analytically instead of graphically so that more accurate aircraft geometry data are available for use in the pressure distribution computer programmes being developed. These computer programmes will be the end-product of an intensive research effort to utilize the finite element techniques to predict the pressure distribution over a complete aircraft configuration. The inviscid potential flow theory is being used. Because of the large size of the computer programmes and computer core limitations, a problem oriented language will be defined and its associated compiler will be written in a higher level language.

Wing-body design in transonic speeds and development of supercritical wings

This project comprises three sub-projects: (1) aerodynamic principles of transonic wind body design; (2) theoretical and experimental investigations of supercritical flows and development of supercritical aerofoils; and (3) configuration and performance optimization.

In the first sub-project, efforts will be concentrated on developing a design procedure for a transonic wing body closely following Lock's work.

In the second sub-project, efforts will be made to develop efficient computer programmes for calculating supercritical flows past aerofoils including shock and boundary layer phenomena. These methods will be subsequently utilized in the development of supercritical aerofoils.

In the last sub-project, recent methods of minimizing a function of several variables with and without constraints will be applied to configuration and performance optimization.

Studies in transonic flow

As a preliminary to the understanding of supercritical wing design, studies on flow past two-dimensional aerofoil sections at transonic speeds have been taken up. Since supercritical wing promises to reduce the operational cost of transport aircrafts and also appears to be of advantage in a military aircraft, this field is a closely guarded secret and hence it is necessary to develop the know-how indigenously. It is proposed to test a number of two-dimensional aerofoil sections developed in consultation with HAL in the high-speed wind tunnels and obtain their characteristics. The experiments would include both force and pressure measurements. Simultaneously, it is proposed to develop computer programmes to calculate the pressure distribution on two-dimensional aerofoils at transonic speeds and also to develop shock-free aerofoil section for a particular design C_L and Mach number and to study their off-design performance.

Design of an inlet for a typical supersonic fighter aircraft

The design and development of an efficient compression system for a supersonic fighter aircraft of Mach number 2·0 capability is envisaged in this project. Both theoretical and experimental investigations are included. The project was initiated during 1971 and a few computer programmes were developed to assist in the design of two-dimensional intakes. Currently, experimental studies on axisymmetric pilot intakes are nearing completion. Plans are under way to conduct tests on two-dimensional external compression intakes.

After-body drag of a twin-jet configuration

After-body drag on an airplane is the sum of boat-tail drag and base drag. For a jet engined aircraft whose engines are buried in the fuselage, the after-body, if not designed with care, can contribute to as much as 20-30% of the subsonic profile drag.

Some of the important parameters on which the after-body drag depends are after-body shape, location and number of jets issuing from the base, free stream and jet Mach number, jet pressure to ambient pressure ratio and jet temperature ratios.

Presently there are no methods of estimating after-body drag, particularly in the case of two or more jets issuing from the base. Hence experiments have been taken up to measure the after-body drag and to optimize after-body configurations.

It is proposed to design and set up a facility in the 4-ft tunnel to test any given after-body, imulating most of the parameters.

Turbulent shear flows and separated flows

There are several problems in turbulent shear flows and separated flows which are relevant to aerodynamic design of advanced technology aircrafts. For instance, the hot jet emerging from variable area nozzle of an aeroengine creates recirculating regions which can lead to large base drag, consequent fuel consumption and loss of performance. As the phenomena involved are not fully understood, a programme of experiments designed to guide the formulation of approximate methods of drag prediction and control has been initiated.

Measurements of dynamic stability derivatives in 3-ft low speed wind tunnel

The project is aimed at developing the techniques for measuring experimentally the dynamic stability derivatives of flight vehicles. The free oscillation technique for measuring the pitching derivatives has been developed and measurements on several cone cylinder models have been made. It is proposed to develop techniques for measuring lateral stability derivative and coupled dynamic stability derivatives. Theoretical methods available for estimating the dynamic stability derivatives are also being studied.

Dynamic stability testing in 1 ft × 1 ft and 4 ft × 4 ft wind tunnels

The purpose of the project is to develop dynamic stability test rigs for testing at transonic and supersonic speeds in 1 ft × 1 ft and 4 ft × 4 ft wind tunnels and to test models of interest to evaluate the dynamic stability derivatives.

Propulsion

Combustion and gasdynamic investigations

A combustion and gasdynamics laboratory was built during the previous years to undertake investigations pertaining to ignition, combustion, mixing and heat transfer in gas flows under controlled conditions. Arrangements for remote control and operation of air supply valves will be made during the current year. Experimental research pertaining to ignition in premixed gas flows using catalytic and chemical ignition methods is in progress. A pressure-insensitive fluidic oscillator for temperature measurements was developed and calibrated up to 900°K. Further investigations on this oscillator are being continued.

Turbine research rig

This is an important facility for conducting aerothermodynamic investigations on turbine stages under conditions closely simulating those in different types of actual turbines. The rig is under installation. It is provided with a high-speed dynamometer capable of absorbing 1600 hp at 26 000 rpm. The rig is built around 20 lb/s of air at a maximum pressure of 7 atm and at a maximum temperature of 400°C.

Cascade investigations

Studies on cascades provide basic data for the design of blade elements of axial flow turbomachinery. A subsonic cascade tunnel, designed and built earlier, is being utilized for tests on steam turbine blades under a project sponsored by an outside organization. To cover the transonic/supersonic range of cascade testing, a high-speed tunnel with a test section of 150 × 600 mm with inlet Mach number of up to 1·5 is being designed and fabricated. A computer programme was developed for the analysis of subsonic subcritical flow in cascades based on the streamline curvature technique.

Internal ballistics of rocket propellants

Internal ballistics, as applied to solid propellants, deals with the combustion and gasdynamic aspects in thrust chambers and nozzles. In order to carry out experimental research on these aspects, it is essential to prepare homogeneous reproducible samples of propellant grains under controlled conditions. A small propellant processing facility is proposed under this project.

Burning rate is a crucial parameter for the design of rocket motors. A strand burner was built to measure the rate at various pressures and temperatures. An apparatus in which γ-ray transducer system is used is under development for measuring burning rate under erosive conditions. Static firings to study combustion oscillations would be carried out after commissioning the propellant processing facility.

Structural Sciences

Studies in optimization in structural design

The use of high-speed digital computers as a tool for automating the analysis or bahaviour prediction of trial designs based on mathematical models of structural systems has become common during the last decade. This has naturally led to efforts to automate substantial portions of the design process and also optimization in structural design. In order to achieve superior structural designs there is need for substantial and continuing research and development activity.

Under this project, efforts are made to develop suitable analytical methods for achieving minimum weight aircraft structure with various static and dynamic constraints, such as strength, stiffness, stability, natural frequencies and flutter.

Static and dynamic responses of structures of flight vehicles including composite structures

Curved panels are widely used in aircraft wings and fuselages. While the structural data on panels loaded in compression and uniform shear are readily available, the structural stability of curved panels subjected to pressure loading in addition to compression and uniform shear is still an unsolved problem. The difficulty is mainly due to the complicated prebuckling stresses caused by the edge disturbances. This problem is being investigated by making use of the recent developments in finite element techniques.

Stress analysis of canopy hood: For canopy hood in aircraft practice, a transparent acrylic sheet ($\frac{1}{4}$ - $\frac{5}{8}$ in thick) is formed to the shape which may be non-circular. This problem is not amenable for easy solution by classical methods. Analysis on the basis of membrane (hoop stress only) and on the basis of thick plates (bending) are both considered. The effect of lower edge clamping is to be studied. This problem will be studied by the use of recent finite element techniques.

Vibration and buckling characteristics of laminated shells: Cylindrical laminated glass-epoxy shells are widely used in rockets and missiles. The effect of interlaminar stresses on the vibration and buckling of the shells is of considerable importance. This problem will be studied both theoretically and experimentally.

Vibration of aircraft wings and helicopter rotor blades

An understanding of the dynamic and aeroelastic behaviour of aircrafts is fundamental from both the control and safety points of view. It is therefore necessary to determine accurately the natural frequencies, modes and the associated damping parameters.

Hence an attempt is being made to improve the existing methods of resonance testing by developing both single-point and multi-point excitation techniques. The improved method of testing will be applied to aircraft wings and helicopter rotors for predicting their vibration characteristics. In addition, the new dynamic testing technique will be extended to predict the structural characteristics, viz. inertia, stiffness and damping matrices, which are essential for aeroelastic studies.

Photoelastic investigations of aircraft structures

In the previous year the problems of stress distribution around cutouts in unstiffened cylindrical shells were attempted. The unstiffened Araldite shells were successfully cast using wax core and Perspex mould. Attempts are being made to extend this casting technique to make integrally stiffened structures which are typical in aircrafts, by machining suitable grooves in the wax core. Internal cavities in wax core were eliminated by centrifugal casting technique. As the problem of the distribution of stresses and strains in integrally stiffened shells with discontinuities has important application in aircraft fuselage structures, it is proposed to investigate it with plain and stiffened cutouts in stiffened cylindrical shells subjected to different loading conditions such as uniform tension, compression, torsion, bending and internal pressure by the use of three-dimensional photoelasticity, electrical straingauges and brittle coating techniques. It is also proposed to set up holography for stress analysis and vibration studies.

Analysis and optimization of reinforced windows of aircraft fuselage

The project is concerned with investigations of stress concentration around openings in shell structures. This problem is frequently encountered in the design of windows and other types of cutouts such as engine bay cutout and launcher bay cutout in aircraft fuselages. The reduction of stress concentration by suitably reinforcing the cutouts will be examined. Also, the problem of optimizing the cutout reinforcement leading to minimum weight design will be investigated. The concept of neutral hole will be extended to shell structures and the significance of curvature in neutral hole design will be studied in all its aspects.

Flutter of aircraft wings and helicopter rotor blades

The problem of flutter in aircrafts is very important and at the same time the theoretical methods are very cumbersome and invariably need experimental verification. As flight flutter testing is very expensive, recourse has to made to model studies.

In this project attempts are being made to design, construct and test both low-speed (subsonic) and high-speed (supersonic) models in order to understand and predict the aeroelastic behaviour of some of the Indian designed aircrafts. In addition, theoretical studies concerning non-linear flutter of panels and shells are also planned.

Study of residual fatigue life of aircraft

The major objective of the study is to determine the residual fatigue life of a certain type of aircraft in service with IAF so that in future more effective methods of operation of the aircraft can be evolved, if necessary, for effective and safe utilization of these aircrafts over a desired period of life as may be decided in relation to the needs of the country.

Development of fatigue facilities

For studying the fatigue of materials and structures a number of test facilities are required; these include fatigue testing machines, and structural test rigs with special capabilities such as load programming and environmental programming. Fatigue testing machines presently being used in research projects have been designed by the laboratory. A fairly sophisticated fatigue test facility for testing full scale airframes is being designed and built in the laboratory. Fighter aircraft up to 50 000 lb all-up weight can be fatigue-tested in the facility. The facility is being built using imported components worth Rs 4 lakh. A similar facility entirely imported would cost Rs 15-20 lakh in foreign exchange.

The facility is essentially a multiple closed-loop survo hydraulic system in which any load history defined in terms of 32 load levels can be programmed on a punched tape and applied on the structure under test.

Awards for Import Substitution and Inventions*

Manufacture of Potassium Carbonate and N-K Fertilizer by Ion-exchange Technique

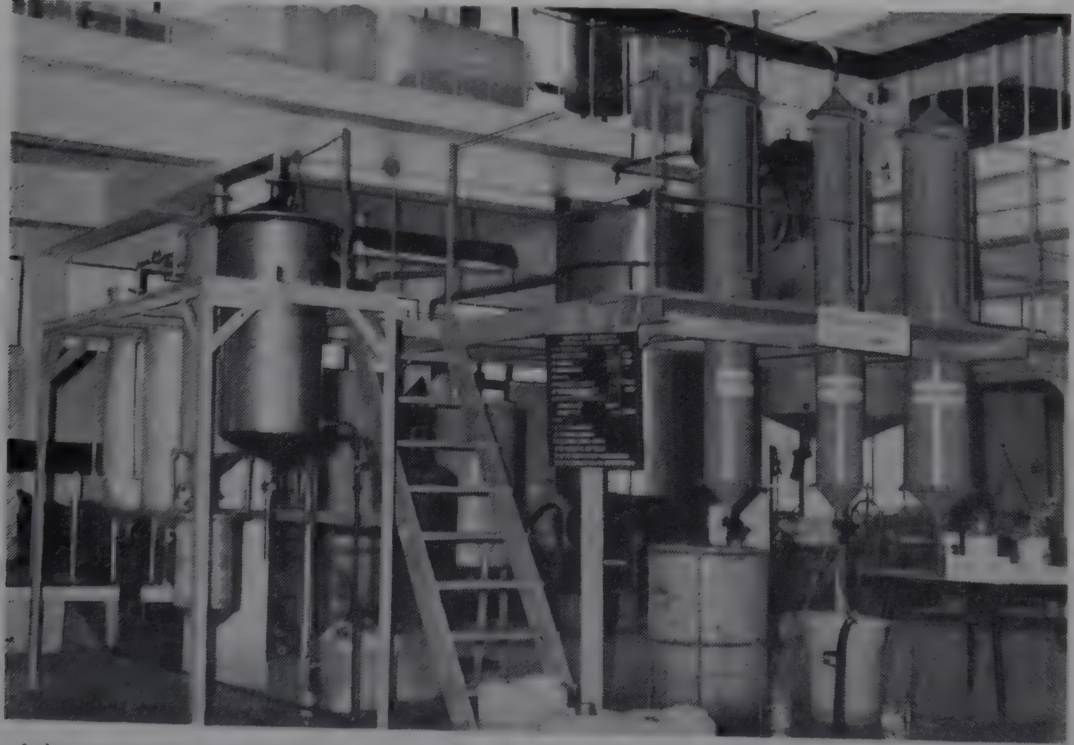
The process developed at the Central Salt & Marine Chemicals Research Institute (CSMCRI), Bhavnagar, is based on ion-exchange and is a departure from the conventional methods for the preparation of chemicals.

Potassium carbonate is generally manufactured either by carbonation of the electrolytic potassium hydroxide or by Engel Precht process. In the first process, about 50% of the plant equipment is imported and the economy of the process depends on the cost of electricity. In the latter process, potassium chloride is heated with magnesium carbonate, water and carbon dioxide under pressure to give a carbonate of potassium and magnesium which is then heated with magnesium oxide to obtain potassium carbonate and magnesium carbonate. The magnesium salt is removed by filtration and the potassium salt recovered from the filtrate by evaporation. This is a complicated process and entails careful control of time, temperature and pressure to obtain optimum yields. Because of the high solubility of potassium bicarbonate, Solvey process (used for the manufacture of soda ash) cannot be employed for the manufacture of potassium carbonate.

The process developed by CSMCRI consists in passing a solution of potassium chloride through a cation-exchange resin bed which is then washed with water. The resin bed is subsequently eluted with ammonium carbonate solution whereby potassium carbonate is obtained in the eluate, which on evaporation and drying yields pure potassium carbonate.

The resin in the ammonium form is regenerated to potassium form by passing potassium chloride solution whereby an effluent containing ammonium chloride and potassium chloride is obtained. On evaporation, this solution yields a mixed fertilizer containing about 28% potash (K_2O) and 14·5% nitrogen. This mixed fertilizer obtained as a byproduct of this process is suitable for those crops which are not susceptible to chloride ions.

The process is simple, and all the equipment required are available indigenously, and hence no foreign exchange is required in the setting up of the plant.



A bench unit for the preparation of potassium carbonate and N-K fertilizer by ion-exchange method set up at CSMCRI

The process has been studied on a bench unit producing 30 kg of potassium carbonate and 40 kg of N-K fertilizer per day. The total capital outlay for a plant capable of producing 3 tonnes of potassium carbonate and 4 tonnes of N K fertilizer per day has been estimated at about Rs 29·50 lakh, including Rs 8·5 lakh as working capital. The cost of production comes to Rs 2100 and Rs 485 per tonne of potassium carbonate and N-K fertilizer respectively as against the market price of Rs 4000/tonne of potassium carbonate.

Greaseproof Paper

The invention relates to the process developed by the Regional Research Laboratory, Jorhat, for the production of greaseproof paper, which finds extensive application in food packaging and as wrappers, from a waste material of jute industry known as jute caddies. Jute caddies consist of fibres recovered as droppings at different stages of jute processing and are available to the extent of 78 000 tonnes/annum in the country.

The process consists in cooking the material under desired conditions, washing the digested material, and beating it with or without prior bleaching. From the beaten pulp are formed sheets of greaseproof papers.

The process has been studied on a laboratory scale. The capital outlay for a plant capable of producing 5 tonnes/day of paper has been estimated at Rs 53 lakh, and the cost of production at Rs 3600/tonne.

Recovery of Anhydrous Pyridine Bases from Aqueous Solutions

This invention relates to the process developed by the National Chemical Laboratory (NCL), Poona, for the recovery of anhydrous pyridine bases from their aqueous solutions.

Dilute aqueous solutions of pyridine bases are obtained mainly in the manufacture of certain synthetic dyestuffs such as solubilized vats. Though the pyridine bases appear to participate in the reaction, they are ultimately released in the free-base form and thus should, strictly speaking, be considered as recyclable non-consumables. However, in practice, there is not only a

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*Continued from 30 September 1972 issue of *CSIR News*.

certain weight loss due to inefficient recovery but also a selective loss in quality, particularly of certain fractions.

The main problem involved in the recovery of the bases is the separation of a large quantity, about 80% by weight, of water from the bases. A common practice to achieve this is to use solid caustic soda to salt out the pyridine bases in a highly concentrated form to facilitate their subsequent distillation to obtain the anhydrous bases. This procedure, however, involves the loss of considerable quantities of costly alkali as dilute, waste solution. Besides, some pyridine bases are also lost in the alkaline aqueous phase. Another practice in vogue involves the use of a suitable entrainer in the direct azeotropic distillation of large quantities of water from the dilute solution of pyridine bases, thus involving a high expenditure of heat energy and other costs.

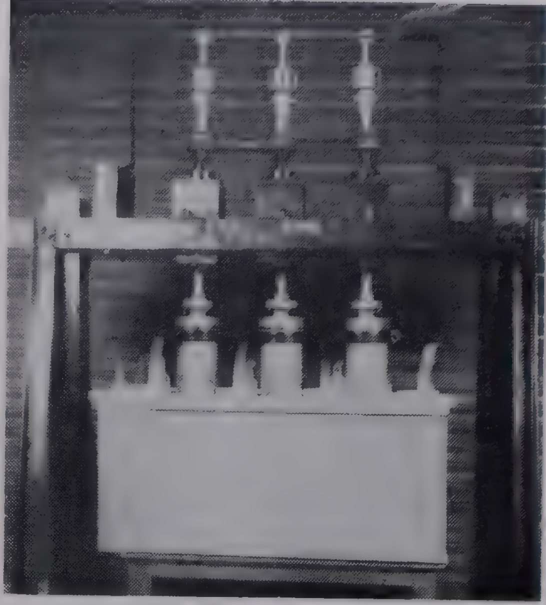
Hence, a logical approach to this problem is to pull out the pyridine bases in the form of a concentrated solution with a suitable recoverable medium. Liquid-liquid extraction is thus an appropriate method, and various solvents are known to preferentially extract pyridine bases from aqueous solution, often also with good selectivity. Since such extracts are not completely free of water, the solvent should also be capable of removing the small quantities of water in the subsequent distillation operation to not only obtain the anhydrous bases but also to recover the solvent for reuse.

The process (Indian Pat. 111311) developed by NCL, Poona, is based on a judicious combination of such procedures. Among the solvents, benzene proved to be suitable, both as an extraction solvent and as an entrainer for the removal of the very small quantities of water in the subsequent distillation of the extract phase; it is also available indigenously at a reasonable cost. Advantage is taken in this process of the temperature effect in liquid extraction as well as of biphase separation of aqueous pyridine base solutions into two layers in certain temperature ranges. A suitable sequence of steps has been evolved to economize benzene requirements. The subsequent distillation is also facilitated by the use of minimum quantities of benzene in the extraction step. The net losses of pyridine bases are less than 5% and benzene recoveries are about 95%. The recovered anhydrous pyridine bases have been found suitable for reuse. The process has been developed on a bench scale. The industrial unit will require simple and inexpensive equipment which can be fabricated indigenously.

About 50% of the total annual imports of pyridine bases, estimated at about 250 tonnes, is for making up the losses of pyridine bases in the process inventory used in dyestuff industries. About 125 tonnes of pyridine bases, worth about Rs 10 lakh of foreign exchange, are currently required for making up the loss (15-20%) incurred due to the present practice. The process developed by the NCL can help significantly to decrease the losses by 70-75%, thus resulting in a saving of about 90 tonnes of imported bases worth Rs 7-8 lakh of foreign exchange. Besides, the loss of considerable quantities of caustic soda or of large amounts of heat energy is avoided. The expenditure on the make-up benzene is, on the other hand, relatively negligible.

Electrolytic Production of Succinic Acid from Maleic or Fumaric Acid

This process developed by the Central Electrochemical Research Institute (CECRI), Karaikudi, involves the electrolytic reduction of either maleic or fumaric acid in a cell having stationary or rotating lead cathode and lead-lined copper anodes covered with blue asbestos thread. The concentration of maleic or fumaric acid is kept between 25 and 30% in 10% sulphuric acid. A current density of 2.5-5.0 A/dm^2 is maintained in the case of stationary cathode and of about 20 A/dm^2 in the case of a rotating cathode. The rotating electrode improves the current efficiency and yield remarkably even at high current densities in the reduction of fumaric acid. The temperature of electrolysis is maintained between 50 and 60°C. A current efficiency of 98% and a yield of 95% are obtained with negligible loss of sulphuric acid. The purity of succinic acid after washing is of Analar quality.


Cell (300A) for the preparation of succinic acid: CECRI

The conventional process has the following drawbacks: (i) the choice of a proper anode chamber complicates the process, and (ii) only low current density can be employed in a stationary cathode cell, especially if fumaric acid is the starting material.

The distinctive features of the new process (Indian Pat. 102485) are as follows:

(1) Use of anode covered with blue asbestos dispenses with a separate anode chamber and anolyte.

(2) The high acidity developing in the anode layer effectively reduces organic discharge at the anode, giving high yields of products.

(3) This improvement along with rotating cathode renders the process easier to scale up and simplifies the cell design.

(4) The method does away with the use of ceramic diaphragms, which are not presently available in the country.

Succinic acid is used as an intermediate in the manufacture of drugs and pharmaceuticals, fine chemicals and analytical grade reagents. It also finds use in the manufacture of dyes, lacquers, esters for perfumes, and several other industrial products.

Succinic acid and its derivatives valued at about Rs 10 lakh are being imported. Indigenous production of the acid will not only save foreign exchange but the product has export potential.

The process has been released to Chemicals & Aromatics, Bombay, who are producing succinic acid with an installed capacity of 60 tonnes/year.

Current Research Projects in CSIR Laboratories—1972

This is the title of a publication brought out recently by the Indian National Scientific Documentation Centre (INSDOC), New Delhi. The publication (demy 4to, 382 pages) lists 1925 research projects which are on hand in 39 CSIR establishments and Industrial Research Associations. Research projects are grouped under seven sections devoted to: (1) Physical sciences; (2) Biosciences; (3) Engineering; (4) Agriculture; (5) Management and transport; (6) Chemical technology; and (7) Manufacture, industries, buildings and architecture. Each section has been further divided into smaller groups according to the Universal Decimal Classification. Entries in the groups have been arranged alphabetically by the title of project, and contain: serial number; title of project; names of project leader and other investigators; name of laboratory; name of sponsoring body, if any; duration of project; and brief description of project.

Location of any aspect of information contained in the compilation is facilitated by the inclusion of indexes relating to investigator, keyword, laboratory, and sponsoring and collaborating agencies.

Proceedings of the Symposium on Chemicals and Oil from Coal

The proceedings of the symposium on Chemicals and Oils from Coal, organized by the Central Fuel Research Institute (CFRI), Dhanbad from 6 to 8 December 1969, have been published recently by the institute. The volume (crown 4to, 552 pages) contains, besides invited addresses, 62 papers presented at the following five sessions: (1) Oil from Coal: State of Art and Techno-economic Feasibility; (2) Hydrogenation of Coal, Liquid Hydrocarbons and Carbon Monoxide; (3) Recovery and Utilization of Tar Oils, Benzole, Naphthalene and Anthracene; (4) Recovery and Utilization of Phenols and Tar Bases; and (5) Direct Conversion of Coal. Floor discussions on the papers presented at each session are also included.

An account of the proceedings of the symposium has been published in *CSIR News*, **20** (1970), 20.

Price Rs 75 or £ 6/$ 15. Copies available from the Central Fuel Research Institute, Dhanbad.

PROCESSES & PRODUCTS READY FOR COMMERCIAL UTILIZATION

Potassium Ethyl Xanthate & Potassium Amyl Xanthate

Potassium ethyl xanthate (PEX) and potassium amyl xanthate (PAX) are used as froth flotation agents in mineral beneficiation.

The present market for PAX is about 30 tonnes/annum, and the projected annual requirement of the National Mineral Development Corporation Ltd alone is about 300 tonnes. The requirement of PEX by Hindustan Zinc Ltd is about 15 tonnes/annum. The present demand is being met partly by imports and partly through indigenous manufacture. At present only one unit in Baroda is manufacturing PEX.

The National Chemical Laboratory (NCL), Poona, has developed a process for the manufacture of PEX and PAX. The process for the production of PEX consists in mixing ethyl alcohol with potassium hydroxide solution and carbon disulphide. The xanthate obtained is dried. Similarly, PAX can be prepared by using *n*-amyl alcohol instead of ethyl alcohol.

The process for the preparation of PEX has been studied on 2 kg/batch scale and that for PAX on 500 g/batch scale. Samples have been tested and found satisfactory. The optimum capacity of a plant for producing potassium ethyl xanthate has been assumed to be 150 tonnes/annum by NCL.

All the raw materials for the manufacture of PEX are indigenously available.

The main items of plant and equipment are kettle with stirring arrangement, flameproof motor, and vacuum drier. All these are indigenously available. No separate plant is needed for the manufacture of PAX.

The total capital outlay for a plant capable of producing 150 tonnes/annum of PEX has been estimated at Rs 5·4 lakh (Rs 2·4 lakh on plant, equipment and building, and Rs 3·0 lakh as working capital). The cost of production comes to Rs 6·20/kg. Since the same process and equipment are used for the manufacture of PAX also no separate costing has been worked out for this chemical.

Further particulars may be obtained from: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

p-Nitrophenol

p-Nitrophenol is used in the manufacture of the pesticide parathion, and in the preparation of *p*-acetamol, an antipyretic drug. The estimated demand for *p*-nitrophenol for parathion manufacture alone is of the order of 300 tonnes/year. At present only two firms are manufacturing *p*-nitrophenol on a small scale.

The National Chemical Laboratory (NCL), Poona, has developed a process for the manufacture of *p*-nitrophenol. The process, which consists in hydrolyzing *p*-nitrochlorobenzene at elevated temperature with aqueous caustic soda, has been standardized on a laboratory scale and has been worked out on 25 kg/batch scale. Tested by Bayers (India) Ltd and Indian Drugs & Pharmaceuticals Ltd, the product has been found satisfactory. The capacity of an economic industrial unit for the production of *p*-nitrophenol as assumed by NCL is 300 tonnes/year.

The raw materials required are *p*-nitrochlorobenzene, sodium hydroxide and sulphuric acid. *p*-Nitrochlorobenzene will have to be imported. Other raw materials are available indigenously.

Mild steel reactor, stainless steel neutralization vessel, stainless steel centrifuge and driers are the main items of plant and machinery. All these are available indigenously.

The total capital outlay for a plant capable of producing 300 tonnes/annum has been estimated at Rs 13.60 lakh (Rs 3.7 lakh on building and plant, and Rs 9.9 lakh as working capital). The cost of production is estimated at Rs 10.20/kg.

Further particulars may be obtained from: The Managing Director, National Research Development Corporation of India. 61 Ring Road, Lajpat Nagar III, New Delhi 24.

CSIR SUPPORT TO RESEARCH

New Schemes

Solid State Chemistry of Complex Oxides of Some Transition Metals

The complex oxides of transition metals constitute an important class of compounds which have been exploited industrially as semiconductors, magnetic materials, and thermistors. The compounds exhibit interesting electrical and magnetic properties depending upon the nature of the transition metal ion and the type of structure adopted. Furthermore, the introduction of point defects by doping with altervalent ions into the crystal leads to remarkable changes in electrical properties. These complex oxides are usually prepared by the interaction of simple oxides of the type AO (MnO, CoO, NiO, ZnO) and B_2O_3 (Al_2O_3, Fe_2O_3, Cr_2O_3) at high temperatures. The complex oxide thus obtained adopts mainly the spinel, perovskite or ilmenite structures depending on the nature and relative sizes of the cations A and B.

In a new CSIR research scheme granted to him, Dr M.V.C. Sastri (principal investigator) of the Department of Chemistry, Indian Institute of Technology, Madras, proposes to prepare the complex oxides of Ti, Zr, V and Mo by (i) solid state interaction of divalent metal carbonates with oxides of Ti, V, Zr and Mo; and (ii) thermal decomposition of complex oxalates of Ti, Zr, V and Mo.

The physicochemical properties of the complex oxides thus obtained will be studied by DTA, TGA, electrical conductivity, magnetic susceptibility and X-ray diffraction techniques.

Nucleophilic Substitution Reactions of α-Halogeno Ethers

Under a new CSIR research scheme sanctioned at the Department of Chemistry, Indian Institute of Technology, Madras, Dr S. R. Ramadas (principal investigator) proposes to study the nucleophilic substitution reaction of appropriate α-halogeno ethers possessing naphthalene unit with a view to extending these reactions for developing a new route to the synthesis of oxa-steroids. α-Napthyloxymethyl bromide (I) and di-α-naphthyloxymethane (II) have been prepared from α-naphthol in good yields. The nature of the product(s) obtained by the addition of various nucleophiles to I and II both under acid and base catalysis will be studied. If expected products are obtained, then the addition of anions, obtained from 2-methylcyclohexa-1, 3-dione and 2-methylcyclopenta-1, 3-dione, to I and II will be studied. The products obtained from such reactions would constitute the key intermediates for the total synthesis of 11-oxa-steroids, which have been recently claimed to be potential anticancer agents.

Productivities of Seedlings of Dominant Tree Species in Deciduous Forests

The dynamics of organic matter accumulation by natural communities like forests is a key factor in formulating long-term programmes for sustained economic utilization of these natural resources. Under the International Biological Programme large scale productivity studies are being conducted in different forest communities—mostly mature ones—all over the world, which have been reviewed from time to time by different workers. However, literature survey reveals paucity of information with regard to the growth mechanics in the seedling stage of trees, which is the most critical phase in the life history. In a country like India where forests are heavily exploited, regeneration assumes great significance in revegetating or improving the vegetal cover of such areas.

Under any given set of conditions, differences in the annual rate of dry matter production can be attributed to differences in one or more of these parameters of growth: net assimilation rate, proportion of productive material within the tree, and duration of the productive period within the annual cycle. The technique of growth analysis makes the determination of these factors possible. Very little is known about the relative efficiency of dry matter production of perennial plants with differing growth patterns, and clearly there is need for such information. Under a new CSIR research scheme granted to Dr K. P. Singh (principal investigator) of the Department of Botany, Banaras Hindu University, Varanasi, it is proposed to take up three dominant tree species of local deciduous forests for studies after a preliminary survey. With the immediate aim to enquire into the seasonal growth patterns of seedlings of tree species commonly found (introduced or naturally growing) in deciduous forests of Varanasi division, this project forms the first step of a long-term study involving the growth pattern in understorey vegetation in relation to energetics and mineral cycling in the community.

PATENTS ACCEPTED

Indian Pat. 128617

An apparatus for the production of both positive and negative dc voltage

R Mariadoss & M. S. Iyengar
RRL, Jorhat

The need for dc voltages is increasing enormously with the growth of electronics industry. Devices for rectification of ac to dc voltage used so far contain either a valve diode or a semiconductor diode wherein the rectified signal is either of a positive or of a negative polarity depending on the mode of connection of the diode. The invention covered by the patent relates to the development of an apparatus in which a single input ac signal gives rise to both positive and negative dc voltages simultaneously in the output stage. Unlike the presently used devices in which two separate units are required to get positive and negative dc voltages, the new device provides both positive and negative dc voltages with a single input signal.

The principle underlying the invention is that the input ac signal is split into positive and negative dc pulses. The rectified signal is phase-reversed and filtered off to get dc voltages.

The voltages thus obtained find application in many of the electronic circuits such as logic circuits, digital circuits, battery eliminators, and control circuits.

Indian Pat. 127751

A process for the regeneration of used lubricating oils

A. K. Biswas, P. V. Krishna & M. S. Iyengar
RRL, Jorhat

Lubricating oils are discarded after a specific period of use as otherwise the engine's life and performance are impaired. The bulk of used lubricating oils (80-90%) remains unchanged and could be economically regenerated. The country's dependence on imports to meet the lubricating oil requirements underlines the need for regeneration of used oils.

The process for the regeneration of used lubricating oils, covered by the patent under reference, is as follows:

Used lubricating oil together with activated fuller's earth and water is heated to a suitable temperature in a closed vessel with constant stirring. The clay-treated oil is cooled and passed through a filter press. The filtered oil is subjected to vacuum distillation. A part of the distillate collected is discarded as heating oil. Distillation is continued up to a constant temperature, ensuring more or less complete recovery of the oil. The distillation residue comprises most of the spent additives and is discarded. The distilled lubricating oil is blended with additives to improve viscosity index and other properties.

The novelty of the process lies in the elimination of sulphuric acid treatment by a severe clay treatment step, thereby avoiding acid sludge handling and disposal problems and in turn making the process as a whole more economical.

Technology Transfer: International Seminar

An international seminar on Technology Transfer is being organized by the Council of Scientific & Industrial Research in New Delhi during December 1972 with the assistance of the United Nations Industrial Development Organization.

Some 60 countries are expected to participate in the seminar, which will deal with transfer of technology: (i) from the advanced to the developing countries; (ii) between the developing countries; and (iii) within the developing countries from research laboratories to industries. A number of industrial topics relating to fertilizers, steel, drugs and pharmaceuticals, instruments, textiles, leather and food industries will also be discussed.

Overseas participants would be confined to those countries which are taking part in the Asian Trade Fair: 1972. Prior to the seminar, visits will be arranged to major centres of science and technology and industrial establishments in different parts of the country.

Symposium on Science and Technology of Sponge Iron and its Conversion to Steel

A symposium on Science and Technology of Sponge Iron and its Conversion to Steel will be held at the National Metallurgical Laboratory, Jamshedpur, in February 1973. The symposium will cover: (1) Physical and chemical characteristics of iron ore and solid fuels, such as raw non-coking coal, and lignite for direct reduction; (2) Fundamental aspects of reduction of iron oxide by solid reductants with particular reference to reduction in rotary kiln; (3) Short-time laboratory tests for ascertaining the suitability of raw materials for undertaking further trials in pilot plants; (4) Pilot plant trials on reduction of size-graded lumpy iron ore with raw non-coking coal, operational and engineering design data to evolve commercial prototypes, and factors to be considered for the design of industrial plants; (5) Design characteristics and limitations of rotary kilns for reduction of iron oxide; (6) Experience of operation of commercial rotary kilns for reduction of iron oxide with solid reductants, operational difficulties in continuous operation and yield, and techno-economic assessment; (7) Future of direct reduction processes based on the use of solid reductants; (8) Fundamental aspects of electric arc steelmaking with sponge iron; (9) Concept and advantages of ultra-high power electric arc steelmaking; (10) Operational characteristics of steelmaking with sponge iron on industrial scale; (11) Comparative evaluation of steelmaking with scrap and optimum amount of sponge iron and scrap; (12) Techno-economic appraisal of steelmaking by the conventional blast furnace/basic oxygen steelmaking processes and alternatives such as sponge iron/electric-arc steelmaking; (13) Techno-economic evaluation of ironmaking in blast furnace with pre-reduced ferrous burden; and (14) Utilization of sponge iron in basic oxygen steelmaking processes. Recommendations will be made in regard to adaptation of appropriate direct reduction and steelmaking techniques for developing countries on the basis of economic and raw material considerations.

Metallurgists, technologists, research scientists, engineers, plant economists and industrialists from India and overseas are expected to participate in the symposium.

Intending participants may write to the organizers of the symposium, Dr A. B. Chatterjea and Dr Y. N. Trehan, National Metallurgical Laboratory, Jamshedpur 7.

Symposium on Development of Ground Water Resources

An international symposium on Development of Ground Water Resources with special reference to Asian Region, sponsored by the Council of Scientific & Industrial Research (co-sponsors: Public Works Department, Government of Tamil Nadu and the Central Ground Water Board) for the Indian National Committee for International Hydrological Decade will be held from 26 to 29 November 1973 at the College of Engineering, Guindy, Madras. Technical sessions will cover: (1) Hydrogeology of aquifers and methods of prospecting for water; (2) Hydrological processes affecting subsoil water tables; (3) Instrumentation and methods of observation (including engineering aspects of extraction); (4) Aquifer management and optimization (including systems analysis and model techniques); (5) Specialized problems in ground water, such as fresh and sea-water interface, natural and artificial recharge, and resource estimation in hard-rock and carbonate rocks; and (6) Planning and administration in ground water development.

Intending participants may obtain further details from: Dr V. C. Kulandaiswamy, Secretary, International Symposium on Development of Ground Water Resources, College of Engineering, Guindy, Madras 25.

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CURRENT RESEARCH PROGRAMMES : NAL[*]

Materials Science

Fatigue life and crack propagation in commercial aluminium alloys

In the design of advanced supersonic fighter aircraft, considerable attention has to be given to the effects of elevated temperatures on aircraft structure. In particular, the effect of heat on fatigue life and crack propagation characteristics has to be considered.

An immediate problem that was of concern to Hindustan Aeronautics Ltd was that some portion of fuselage structure, constructed with Al-Zn-Mg and Al-Cu-Mg alloys, gets heated up due to ground runs of the engine. Initial studies are being carried out to determine the effect of heat on fatigue life and crack propagation in these alloys. The data would be useul for designing advanced supersonic fighter aircraft.

Preparation and analysis of materials

It is proposed to set up facilities for the preparation of polycrystalline and single crystal materials. A single-arc furnace for preparing and melting materials will be set up. Growing of crystals by the use of some conventional techniques like Remercas flux growth method will also be undertaken. The feasibility of applying some of the electroanalytical techniques for trace analysis will be examined. The determination of wear metals in engine oils by atomic absorption spectrophotometry will be taken up.

High pressure studies

The response of various materials, particularly solid and liquid metals and some ceramics, under high pressure and high temperature conditions will be studied. Additionally, it is intended to investigate the possibilities of technologically useful high pressure phases in metals and alloys and to synthesize some of the electro-optical and abrasive materials which can be synthesized only under extremely high pressures. Chromium and some of its alloys and vanadium and its alloys have been investigated so far. The behaviour of mercury and its amalgams is being studied.

Analysis of materials by X-ray diffraction

Investigations on the failure of nimonics 105 turbine blades in aircraft engines have been undertaken. In this connection it is required to measure the residual stresses in the blades by X-ray diffraction techniques. Owing to the presence of various elements (Co, Mo, Cr, Fe, Ti, Mn and Ni) in nimomics 105 a very high background in X-ray photograph is encountered. A series of trial pictures revealed that FeK_x radiation gives good peak-to-background ratio. A calibration curve is being drawn.

High temperature materials

Three projects, viz. (i) dispersion strengthening of titanium, (ii) phase transformation in Ti-6Al-4V, and (iii) thermomechanical treatment of 2024 aluminium alloy, are on hand.

Powder metallurgical techniques are used on internally oxidized titanium-rare earth alloys to produce dispersion-strengthened titanium.

Strengthening associated with quenched and tempered Ti-6Al-4V is under investigation.

Fatigue and elevated temperature creep characteristics of substructure-strengthened 2024 aluminium alloy produced by thermomechanical treatment (TMT) is being evaluated. Fundamental studies on the effect of TMT on some dispersion-strengthened systems ($Cu-Al_2O_3$ and $Fe-Al_2O_3$) are also to be made.

FRP components and fabrication processes

It is proposed to develop processes and products for Handlay-up, vacuum and pressure mouldings, matched die mouldings and related work in fibreglass reinforced plastics (FRP) using different glass-resin-filter combinations. Design and fabrication of the necessary moulds and tools, e.g. radome panels, antenna reflector dishes (plain parabolic and complex multi-curved contours), audiometer boxes, respirators, helicopter blades and sandwich structures, will be undertaken.

Processes and products for filament-wound reinforced plastics involving the use of optimum winding parameters and meterial combinations to get the desired physical and mechanical properties, e.g. centre-fed antenna elements, lightweight antenna masts, loading coils, nose cones, roosters, and pressure vessels, are contemplated.

Design, development and fabrication of machines and equipment for the above work is envisaged.

Processing and fabrication of materials

Two major projects under way relate to: (i) production of high purity chromium; and (ii) development of electrochemical milling machines and methods.

Electronics

Fabrication of digital devices and systems

There is a growing need for digital data logging systems in all branches of engineering, especially in aeronautical and structural engineering. A wide selection of transducers of advanced design and remote measurements has led to the development of the digital data systems.

The system measures, digitizes and punches/prints the data originating from various transducers like straingauges and thermocouples. The main components of these data system include scanner, signal conditioner, A/D converters, code translator, digital recorder or printer.

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[*] Continued from 15 October 1972 issue.

A radio reporting raingauge system has also been designed and fabricated under this project. This measures the number of pulses from the tipping bucket raingauge transducer and stores it in a digital counter. The information stored in the counter is a cumulative record of the rainfall. This information is converted into a 'dash dot' code and is connected to the transmitter.

High power circuits

Projects contemplated in this field are concerned with: (i) development of a high energy capacitance discharge system for generation of high intensity magnetic fields for applications in acceleration of macroparticles, plasma and magnetoresistance studies; (ii) development of a solid-state variable energy spark ignition system for jet engine research; and (iii) development of a pulsed current source of several thousand amperes capacity for work in high magnetic field.

Analogue techniques

High accuracy potentiostats are proposed to be developed.

Development of a linear power controller circuit using thyristors for temperature control applications will be undertaken. The following items are also contemplated under this project: (i) development of dc motor speed controller (accuracy ± 0.25%) using solid-state devices; and (ii) development of temperature controllers to provide different programmable heating and cooling rates.

Digital techniques

A feasibility study on the development of an airborne digital computer is being carried out.

Other projects planned in this area include: studies on computer graphics and display systems (part of the work is expected to be supported by Defence Organizations); and development of a faster analogue-to-digital and digital-to-analogue converters and improved data logging systems.

Instrumentation

Control systems for structural fatigue loading of aircraft

A project on the design, fabrication, and commissioning of multiple input-output electrohydraulic feedback control system for fatigue tests of full scale aircraft has been undertaken. The system translates in flight the load envelope of aircraft through a 5-channel paper tape and distributes the various manoeuvre loads through 6 loading jacks and wiffle trees. Stability and accuracy analysis have been completed and 0.5% load accuracy has been obtained. The control system will be used to load full scale aircrafts to study their fatigue characteristics and safe life.

Control system for structural harmonic excitation

The study of control problems involved in closed-loop control of amplitude and phase of structural vibrations with multiple point excitation is being undertaken. This will assist in the study of aircraft, helicopter and engine vibration characteristics.

Manual control studies of aircraft type situations

A fixed base 3 degrees of freedom simulator is being used for investigating the pilot dynamics and quasilinear pilot describing functions. Investigations are also under way in the area of pilot visual displays. This work will be extended to the study of pilot dynamics with combined visual and motion cues. The motion cues will be generated for 3 degrees of freedom using motion cues of pitch, roll and heave. The pilot dynamics data will aid in handling quality studies of aircraft and assist in optimal design of flight control equipment.

Range and flight instrumentation and telemetry systems

The development of a digital phasemeter (accuracy, 0.1°) for the automatic reading of the phase between the force and the response in the study of dynamic characteristics of structures will be taken up.

A frequency synthesizer, a system that will give highly accurate discrete frequencies from 1 Hz to 10 kHz with a spacing of 1 Hz, will be designed and fabricated.

Calibration standards for pressure, temperature and vibration

This is a continuing project aimed at the creation of additional facilities to the existing calibration facilities.

A primary calibration facility for accelerometer and vibration pickup based on the reciprocity method and using a bilateral electromagnetic vibrator will be developed.

A ballistic pendulum calibrator will be designed and developed to determine the response time of accelerometers and also for the calibration of shock measuring accelerometers.

For fixed amplitude calibration up to the range of 3 mm, target gauges are proposed to be designed.

Studies on the dynamic response of pressure transducers, using shock tube facility, will be taken up.

General calibration, test and evaluation of pressure transducers, accelerometers, and vibration pickups will be undertaken for actual users.

Fabrication of electrical transducers and associated instruments

The aim of this project is to produce on a batch production basis various devices and instruments developed in the laboratory. These are essentially required for the measurement of physical parameters such as pressure displacement, strain, temperature and vibration encountered in the field of aeronautics. These devices and instruments were hitherto being imported.

Electrohydraulic control systems

This project deals with fabrication of servo type electrohydraulic systems for various requirements like aerodynamics, structures, fatigue, and motion base simulator drive using mostly indigenously available components. It is intended to build up capability in type testing of aircraft quality hydraulic systems.

Sensor technology

The main aim of this project is to develop various load cells, pressure transducers and sensing devices using various types of sensing principles for the measurement of loads, pressure torque and the like.

Items under development include: tension and compression type load cells (500 g to 20 tonnes); pressure transducer for gauge and differential pressure measurements (0.25 to 5000 psi pneumatic) using both LVDT and straingauges as sensors; pressure transducer for measurements of pressures (5000 to 50 000 psi hydraulic); and miniature transducer using unbonded straingauge techniques.

Semi-large scale production of straingauges will be taken up and continued to meet the country's needs and ultimately the know-how will be handed over to industry.

Instrumentation for creep testing machine

This project is a part of an interlaboratory project for the development of creep testing machines. The other two laboratories collaborating in this project are the National Metallurgical Laboratory, Jamshedpur, and the Central Mechanical Engineering Research Institute, Durgapur.

The work involves a study of sensors and signal conditioners for precise measurement on the specimen of temperature (± 1°C between 100 and 800°C), precise measurement of extension (± 1μ; max extension 2000 μ; stability ± 0.5 μ) and precise control of creep furnace temperature (± 1.0°C between 100 and 800°C; stability ± 0.5°C). A data logging system which gives out a printed digital information of the parameters being measured will also be designed and developed. The instrumentation has to be exceptionally stable and reliable for continuous operation to a maximum of 10 000 hr.

Awards for Import Substitution and Inventions*

Intra-ovarian Injection Device for Animals

Designed and fabricated by the Central Drug Research Institute (CDRI), Lucknow, this device is used for injecting liquid drugs or chemicals directly into the deep-seated internal organs, such as ovaries of large female animals. With the help of this device —Centovaian injection device is its functional designation—a simple non-surgical intraovarian injection technique has been developed primarily for sterilizing uneconomic and unproductive cows in the country. This has resulted in the successful development of a simple, cheap, bloodless and cent per cent effective chemical method for sterilizing useless scrub cows and buffalo cows. This invention should go a long way in developing and improving the cattle industry by preventing the multiplication of genetically poor and inferior cattle. This will indirectly help increase the country's food production by allowing the superior and economic milch and draught breeds of cattle to develop to their optimal capacity with the resultant increase in milk and work output respectively.

The device consists essentially of three specially designed removable parts, viz. cannula (45 cm long), trocar (59·4 cm long) and injection needle (47·5 cm long), and a 5-ml record syringe to be fitted with the needle during actual injection. The cannula and the long injection needle, both made of stainless steel, are provided at their bases with suitable clutching arrangement and spring action to regulate the protrusion and automatic retraction of the tip of the injection needle outside or inside the lumen of the cannula as required. Through proper adjustment and manipulation of the three essential parts, the following operations required for intra-ovarian injection in large animals can be carried out: (i) puncturing of the vaginal wall or the skin, (ii) controlling the depth of penetration of the injection needle into the ovary at two stages, (iii) fixing the needle at the required depth (0·5 cm or 0·9 cm), and (iv) retracting the needle to its protected initial position inside the cannula.

A single intra-ovarian injection of cadmium chloride solution (0·25-5·0%, 1·5-2·0 ml per ovary) administered with the help of this device can cause complete destruction of the ovaries of cows, rendering the animals permanently sterile without marked ill effects on their health. The cost of the chemical required to sterilize about 18 000 scrub cows would be only about Rs 30. There is no such suitable device available in India or elsewhere. Produced on a mass scale the device would cost only about Rs 50 each. The efficacy of the device has been tested on about 15 buffalo cows and 80 scrub cows.

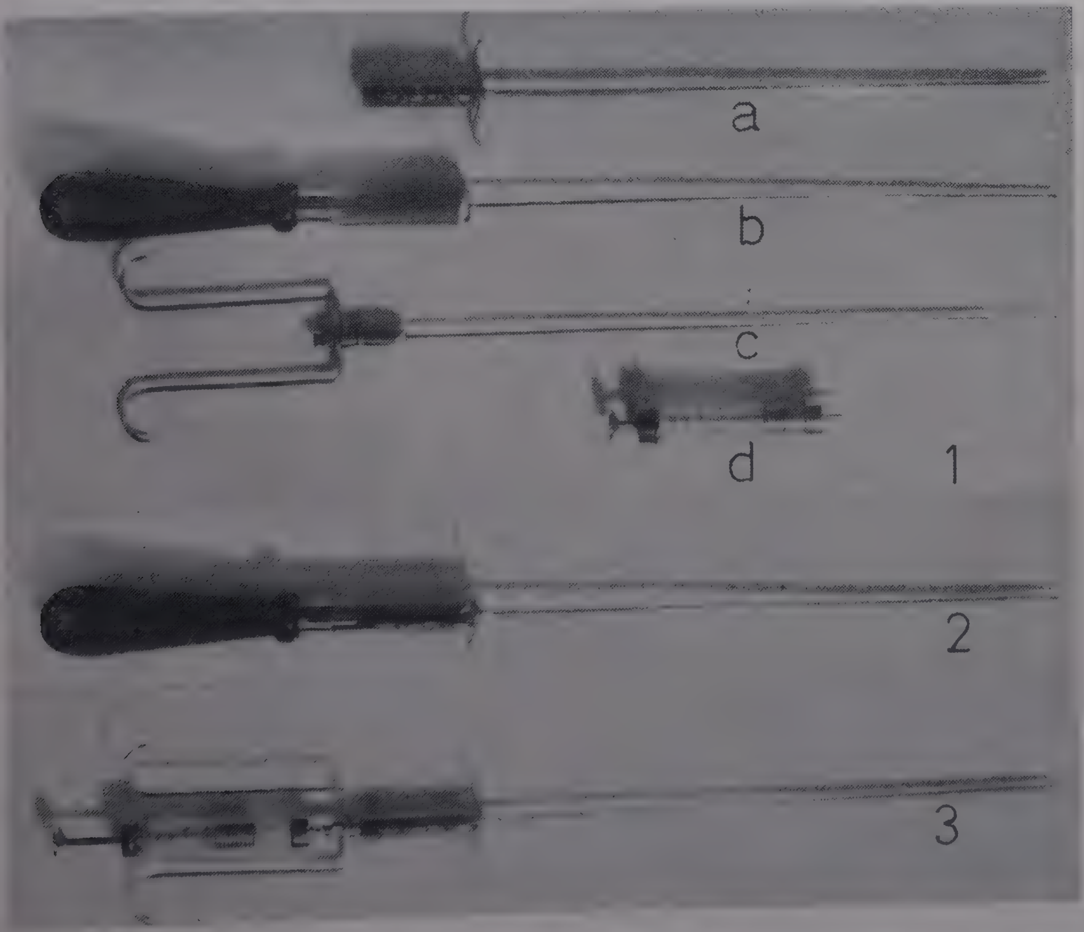

Fig. 1 — Device for intra-ovarian injection in large animals. [a cannula, b trocar, c long injection needle, and d 5-ml record syringe]

Fig. 2 — Cannula fitted with trocar inside as the first stage of assembly of the parts for penetrating the vaginal wall to approach the ovary

Fig. 3 — Cannula fitted with the long injection needle and the syringe as the final stage of assembly of the parts for intra-ovarian injection

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*Continued from 15 October 1972 issue.

Some extended uses of the device are listed below:

1. The device could be used for spaying cows and heifers with a view to fattening the animals for purposes of beef production.
2. Unwanted pregnancies in the case of useful animals like mares, donkeys, camels and elephants can be prevented.
3. It could also be used in the treatment and cure of some infertility conditions encountered in large female livestock due to diseases of internal genitalia like cystic ovary (follicular or luteal cyst), hydrosalpinx, pyosalpinx, parovarian cyst, and uterine or vaginal cyst. The toxic fluid in such cases can be removed from the diseased organs with the help of the device and suitable drugs can be injected directly into the organs for curative purposes.
4. It is easy to handle and can be managed by veterinarians or paraveterinary personnel like stockmen and compounders with a short training.
5. The device will be useful in animal husbandry development work, primarily to improve cattle industry, and is likely to be in demand by the veterinary and animal husbandry departments. There is also scope for its commercial utilization by veterinary instrument manufacturers.

Ultrasonic Transducer Element and Transmitter–Receiver System

Developed by the National Physical Laboratory (NPL), New Delhi, the ultrasonic transducers are capable of sending and receiving ultrasonic beam in air and find a variety of applications as in remote control devices, alarm systems and automation. These devices are capable of sensing liquids or solids, ferrous or nonferrous metals, and opaque or transparent materials at a wide range of distances.

Resonant type of piezoelectric transducers, these devices can be designed to have a desired fixed frequency in 25 kc/s to 50 mc/s range. Ambient conditions such as humidity, water vapour, fog, smoke or dust-laden atmosphere, high or low intensities of light or total darkness do not affect the functioning of the system. These transducers can be used both as transmitter and as receiver for ultrasonic waves in air.

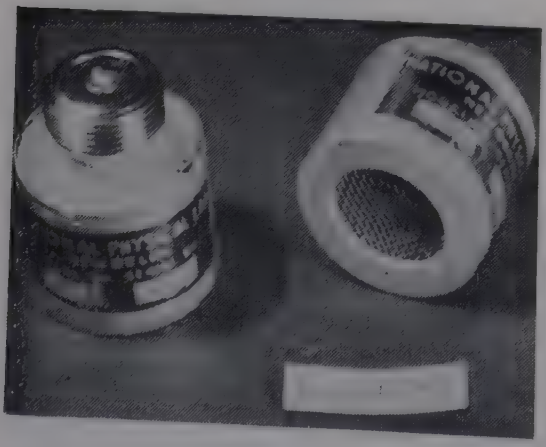

Fig. 1 — Two finished ultrasonic transducers designed and fabricated by NPL

Two such matched transducers can be used in a control unit using transistor circuitry. Two finished units are shown in Fig. 1.

A transducer unit designed for the range and sensitivity required can be used in various applications of automation, sensing and in various remote control applications. A large variety of functions can be performed with the help of these transducers. A complete remote control unit along with the two transducers is shown in Fig. 2.

A typical application of these transducers is shown in Fig. 3. Two

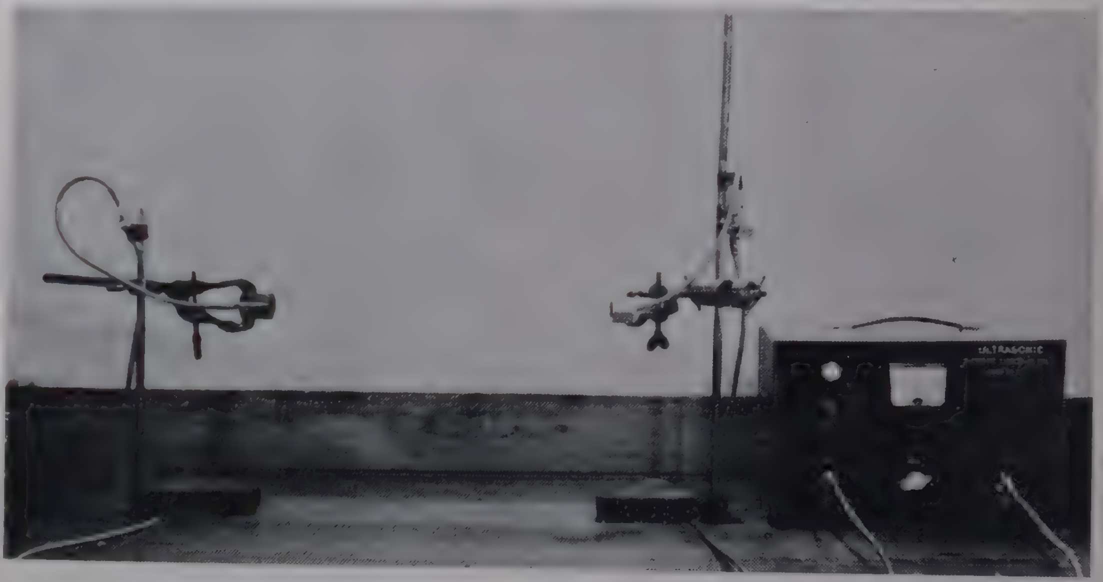

Fig. 2 — A complete ultrasonic remote control unit along with two transducers

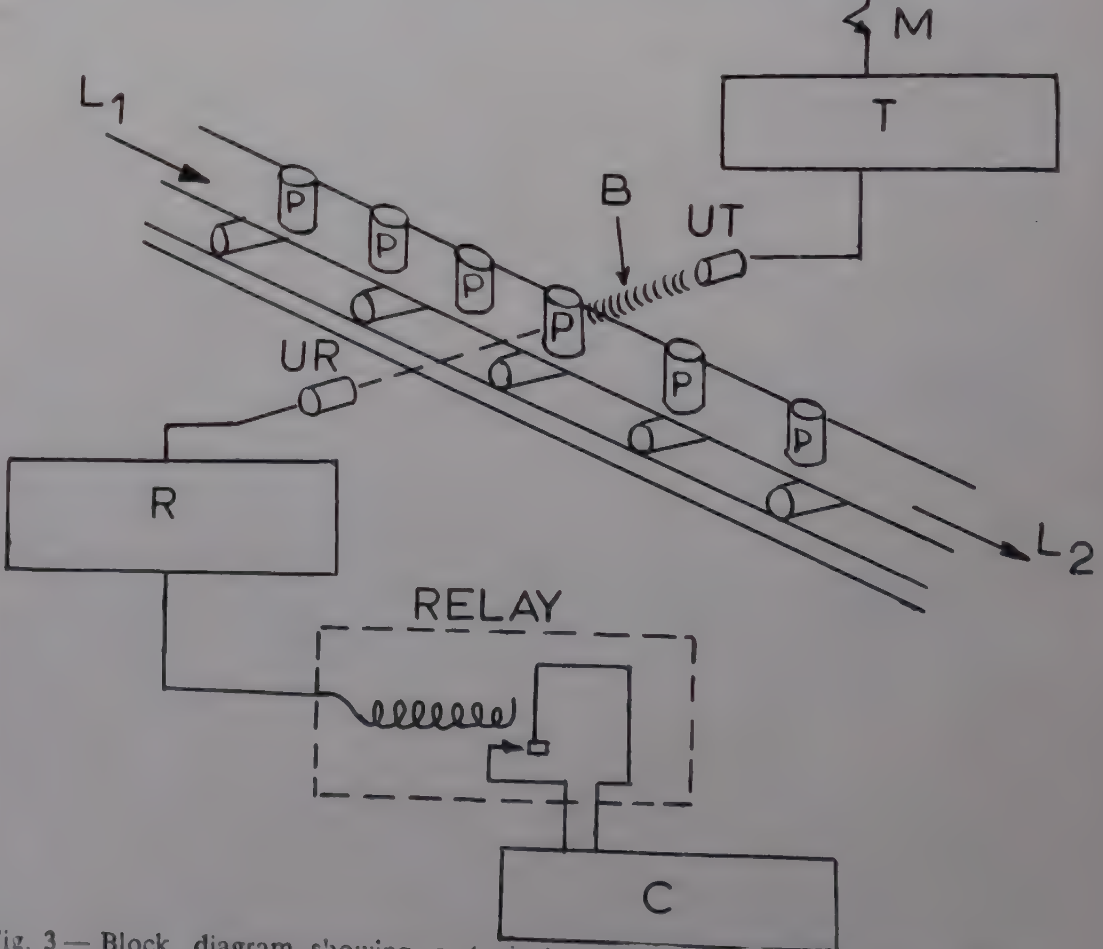

Fig. 3 — Block diagram showing a typical application of transducers (*see* text for explanation)

matched transducers, one working as ultrasonic transmitter (UT) and the other as ultrasonic receiver(UR), are used in automatic counting of packages (P) on a conveyor line (L_1L_2). As long as the ultrasonic beam (B) from the transmitter to the receiver is uninterrupted an amplified, steady current from the amplifier (R) flows through the relay. As the packages move forward they intercept the ultrasonic beam (B), and each time when the beam is cut off the steady current also stops and the relay clicks, registering the next number on the counter (C). Similarly, these transducers can be used in a number of applications such as presence detection, alarm systems, liquid level control, automatic door opener, size control, automatic length control, positioning, package routing, and motor vehicle detection. These transducers are specially useful where an ordinary photocell, operated by a beam of light cannot be used. The transducers are also finding wide applications as a source of ultrasonic waves in air for performing a number of experiments in research laboratories.

The know-how for the production of these sensing devices has been released to Vibronics Ltd, Bombay, for commercial exploitation. The cost of production of a complete remote control unit is Rs 1250; an imported unit costs about Rs 2000.

Agar-Agar from Seaweeds

This invention relates to the know-how developed by the Central Salt & Marine Chemicals Research Institute (CSMCRI), Bhavnagar, for the manufacture of agar-agar from Indian seaweeds.

Agar-agar is a seaweed colloid extracted from selected species of red algae. The agar yielding seaweeds, viz. *Gelidium* and *Gracilaria*, grow on the coral islands in the south and also to some extent at Chilka Lake in Orissa. Until recently the entire requirements of the country in respect of agar-agar (about 30 tonnes / annum) were imported. The country's requirements are now being met by indigenous production.

Process: The seaweeds are washed with seawater, and after disintegration the mass is washed well with fresh water and macerated in a wet grinder. The pulp is again washed with fresh water, added to boiling water in a steam-jacketed open kettle. The mixture is boiled for 2 hr to extract the polysaccharides. The contents are filtered and the clear filtrate is bleached, subjected to freeze thawing and is finally dried at 60°C in a current of hot air. The agar thus obtained is powdered to the desired degree of fineness in a pulverizer.

The product obtained conforms to U.S.P. and B.P. specifications, and has higher gel strength and better colour. It finds extensive use in food, textile, confectionery, cosmetic and photographic industries and in microbiological laboratories. A project report for producing agar-agar on 160 kg/day scale has been prepared by the institute and is available through the National Research Development Corporation of India.

The know-how has been released to four firms who have started production.

The essential items of plant and equipment required in the manufacture of agar include disintegrator, washing tanks, wet grinder, extractor, filter, refrigeration plant, drier, pulverizer, and boiler for generating steam.

The capital investment for the manufacture of agar-agar has been estimated at Rs 5 71 400, comprising Rs 76 300 on land and building, Rs 3 73 300 on plant and machinery, and Rs 22 600 as working capital. The cost of production comes to Rs 10/kg.–[*See also CSIR News*, **19** (1969), 55].

Geothermal Energy Utilization: NGRI's Surveys Reveal Prospective Localities

About 300 hot water springs are known to occur in different parts of India. Many of them have temperatures near boiling point. These hot springs and other geothermally anomalous regions in the country could be prospective localities for the utilization of geothermal energy. The National Geophysical Research Institute (NGRI), Hyderabad, has been engaged in a study of the thermal state of the various geological units and the hot springs. Geothermal gradients (rate of increase of temperature with depth) and thermal conductivity of rocks have been measured for a large number of locations, covering various geological provinces in the country. The data have demarcated various geothermally anomalous regions. It has been found that the subsurface temperatures vary from 1°C to about 7°C per 100 metre depth and the surface heat-flow from 0.6 μcal $cm^{-2}s^{-1}$ to 2.5 μcal $cm^{-2}s^{-1}$. The regions where the geothermal gradients are twice as much as the normal geothermal gradient (3°C/100 m) are Cambay-Kathana region of Cambay basin, and many areas within the Damodar Valley coalfields. The laboratory has also carried out preliminary geothermal surveys and studies in various hot spring areas in the country. Detailed studies in the Pugga valley (Ladakh) and Manikaran region (Himachal Pradesh) have shown that the shallow temperature gradient and conductive heat-flow in these two regions are much higher than those found in normal continental areas. Prospects of encountering high enthalpy fluids ($>$180°C) at greater depth in the above two areas are bright.

Utilization of Kutch Lignite: CFRI's Feasibility Study

A feasibility study on the utilization of the lignite deposits occurring at Panandhro (Kutch Dist., Gujarat) has been completed by the Central Fuel Research Institute (CFRI), Dhanbad, under a project sponsored by the Gujarat Mineral Development Corporation. The extractable reserves of lignite (bed thickness 1 m and above) are estimated at 41 million tonnes.

The institute has made the following recommendations:

(1) Top priority be given to the production of smokeless domestic fuel by CFRI formed coke process (Indian Pat. 99655). It is estimated that a 500-tonne/day formed coke plant according to CFRI process will involve mining and supply of 1310 tonnes/day (4 32 300 tonnes/year) of raw lignite, and an investment of Rs 9.92 crore, including Rs 1.25 crore in foreign exchange. The ex-plant selling cost of the product will be about Rs 274/tonne including a 20% profit. A market survey carried out shows that towns with a population of about 5000 and

within 600 km from the plant site will account for about 2.5 lakh tonnes/year of coke produced. The survey also shows that the delivered cost per therm (1 00 000 Btu) of coke ranges from Rs 1.52 to 1.64 and will cost an average family about Rs 20 a month. The delivered cost of coke may be lower when the product is transported by sea. The characteristics of the coke, which is completely smokeless and possesses good combustion characteristics, are: moisture, 1.2%; ash, 26%; and volatile matter, 14%. An engineering consultant firm may be appointed for making a further detailed project report in this connection.

(2) In view of the limitations of transport and availability of water (the region receives scanty rainfall), the preparation of a project report for power plant is considered premature.

(3) The setting up of a thermal power plant with transported lignite at other sites may be considered.

(4) The possibility of supply of fresh water for power generation making use of lignite at site may be explored.

Photochemical Studies of Fatty Materials

Chlorophyll-sensitized peroxidation of saturated fatty acid esters has been studied by Shri Y. Sitarama Sastry of the Regional Research Laboratory, Hyderabad, under the direction of Dr G. Lakshminaryana of the laboratory.

Autoxidation studies carried out earlier on saturated fatty acids, esters and glycerides at moderate (120°) to high temperatures (200°) indicated α-, β-, and random oxidations, but did not throw light on the initial site of oxygen attack. Chlorophyll was employed as a photo-sensitizer in the present investigation to peroxidize saturated fatty esters (caprate to stearate) under mild conditions at room temperature by intermittent exposure to light from a 500-W tungsten bulb. Hydroperoxides were isolated from peroxidized esters by solvent-partition, reduced to hydroxy esters and purified by silicic acid column chromatography and preparative thin-layer chromatography. Analysis of hydroxy laurate and hydroxy stearate by GLC, TLC, IR spectrophotometry, NMR and mass spectroscopy showed the exclusive presence of 2-hydroxy esters. It was confirmed that in chlorophyll-sensitized peroxidation of saturated fatty acid esters under mild conditions, oxygen attacks exclusively the α-methylenic carbon atom adjacent to carboxyl ester. The effect of carboxyl ester moiety was further substantiated by the absence of peroxide development in chlorophyll-sensitized peroxidation of *n*-hexadecance under similar conditions.

Photodestruction of fatty materials has also been studied. The bleaching behaviour of chlorophyll in various fatty substrates and hydrocarbons was studied by exposing the sample, containing 0·05% of chlorophyll in glass tubes sealed under vacuum at 1 mm of Hg, to light from a 500-W tungsten bulb. Exposure to light and the presence of oxygen at least in traces were found necessary for bleaching. Bleaching seems to depend on the facility of formation of peroxy-free radical from a substrate molecule and subsequent abstraction of proton from chlorophyll. The resulting chlorophyll-free radical reacts with oxygen to give a peroxy-free radical of chlorophyll which stabilizes itself to a peroxide in combination with a proton.

A comparative study of photodecomposition and thermal decomposition *in vacuo* of hydroperoxides is of interest. Methyl oleate hydroperoxides were decomposed in sealed tubes under vacuum at 1 mm of Hg either by exposing to light from a 500-W tungsten bulb or by heating in the dark at 63°. Heat treatment caused a faster fall in peroxide value than exposure to light. Free acids, hydrocarbons and epoxy compounds were among the products of decomposition. The formation of similar decomposition products suggests that the mechanism of decomposition is the same in both the treatments.

Destruction of cyclopropene fatty acids of cottonseed oil on exposure to light from a 500-W tungsten bulb was studied under various conditions in the laboratory. Halphen test was used to follow the destruction. Visible light exerted a strong catalytic effect and oxygen, at least in traces, was necessary. Halphen response was eliminated in 4-12 hr from refined cottonseed oil (0·2-10 ml) sealed in a 50-ml flask at 1 mm of Hg without apparent peroxide development. No significant difference was noticed in the peroxide development pattern of the exposed and unexposed samples in the air-oven stability test.

The researcher Shri Sitarama Sastry was awarded Ph.D. degree by the Andhra University for his thesis based on the studies.

PROCESSES & PRODUCTS READY FOR COMMERCIAL UTILIZATION

Carbon Black

Carbon black is largely used as a rubber reinforcing agent: about 95% of the world's production of carbon black is consumed by the rubber industry, especially in the production of tyres, heels and mechanical goods for imparting toughness. It is also the basic raw material for most of the black printing inks. The pigment in black plastics, paints, lacquers and enamels usually consists of carbon black.

Demand and production: Although the production of carbon black was started in the country in 1962 by Phillips Carbon Black Pvt Ltd, Calcutta, the total production including that of United Carbon, who established production recently, is not sufficient to meet the country's requirements. Carbon black is therefore imported in considerable quantities. For example, more than 1000 tonnes of carbon black (valued at about Rs 23 lakh) were imported in 1969-70 to meet the rubber industry's requirements alone. This apart, nearly 1900 tonnes of the material (value Rs 53 lakh) were imported in the same year to meet its demand from other industries.

The requirement of this material by the end of third Five-Year Plan had been estimated at 30 000 tonnes/annum. Against this the Government of India has already approved three projects with a total capacity of about 110 million pounds/annum. Of these, Phillips Carbon Black Pvt. Ltd, Calcutta, and United Carbons, Bombay, have already started production.

Conventional processes: Carbon blacks are manufactured by either partial combustion or thermal decomposition of gaseous or liquid hydrocarbons. The conventional processes for the production of carbon black are : (i) channel process in which natural gas is burnt in a restricted amount of air when carbon black is deposited on cooled channels, with a yield of only 5%; (ii) furnace combustion process in which gas or oil fuel stocks are used and the carbon black is produced in a diffusion flame, confined by a refractory furnace, through thermal decomposition of the portion of the gas oil by the heat liberated as a result of the combustion of the remainder of the oil, the yield being 30-40%; and (iii) thermal process in which natural gas is completely burnt initially in a chequer-work brick furnace, thus heating it, followed by the passage of the gas through a heated channel and cracking at 1400°C, the yield being about 20%.

New Process: Because of the shortage of the conventional raw material used in carbon black production, the country could not make significant progress in this direction. The supply of natural gas is very meagre and the oil refineries do not produce sufficient residual materials for producing carbon black.

In a quest for self-reliance and self-sufficiency with regard to this vital industrial raw material, investigations were undertaken at the Regional Research Laboratory (RRL), Jorhat, and know-how for the conversion of highly volatile vitrain-rich and low-ash coals of Assam to carbon black has been successfully developed. The process consists in crushing the hand-picked coal, fine grinding and subjecting it to flash decomposition and subsequent pyrolysis of the volatile components *in situ* in a fluidized-bed refractory reactor at a fixed temperature, air being used as the fluidizing medium. The heat required for the process can be supplied by the partial combustion of the coal. After the initial separation of the char in a cyclone separator, the carbon black may be recovered from the flue gases by water-scrubbing and electrostatic precipitation. Carbon black is then pelletized and dried at 300-400°C. The yield of the carbon black is about 20% of the coal.

The carbon black prepared in the laboratory has been tested by a reputed firm engaged in tyre manufacture, and found suitable for rubber industry, especially for the manufacture of mechanical goods.

Coal, the only raw material needed, is available in Assam in plenty.

The essential items of plant and machinery required are : jaw crusher, hammer mill, reactors, air blowers, electrostatic precipitators, conveyor belts, air flow meters, temperature recorder, water pumps, hoist, pelletizing units, mixing and rotary drying unit, platform balance, and exhaust fans.

The total capital outlay for setting up a plant capable of producing 30 000 tonnes/annum of carbon black has been estimated at Rs 220 lakh. The cost of production comes to about Rs 680/tonne. If the price of byproduct char is taken into account and the price of coal is taken at Rs 80/tonne, the cost of production will be Rs 560/tonne.—[*See also CSIR News*, **21** (1971), 97].

Further particulars may be obtained from : The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

Etching of Aluminium Foils

Etched aluminium foils are used for the manufacture of aluminium polarized electrolytic capacitors. Capacitors of various working voltage capacitance ratings are used in all types of electronic measuring instruments and equipments, radio, TV sets, etc.

Etched aluminium foils are being produced in the country by a few firms. However, the entire production is being consumed by them for their own production of capacitors, and those units which do not produce these foils depend on imports. The demand for etched foils of aluminium in terms of capacitors is estimated at 150 million pieces by the end of 1973-74.

The conventional process for etching aluminium foils is to treat the foil anodically in a soluble chloride solution using ac, or ac-superimposed dc, or square wave or pulsating dc. Etching in sodium chloride electrolyte using dc does not give an etch ratio of more than 12 at 30 V. Alternating current superimposed dc involves the use of ac of frequency greater than 130 c/s and having a high degree of pulsation. Special generators for the ac source as well as suitable filters and chokes are needed. Similarly, special type of equipment are required to produce square wave or pulsating dc current. These are costly, and may have to be imported.

Process: A suitable formulation for etching aluminium and aluminium alloy using dc to obtain the desired high etch ratio (> 38) at 30 V has been successfully developed by the Central Electrochemical Research Institute, Karaikudi. The process consists in electrochemical etching of aluminium and its alloy in a bath which comprises a soluble chloride like sodium chloride or hydrochloric acid solution.

The process has been studied on a pilot plant designed for processing 4 in. wide aluminium foil rolls. The plant is still in operation.

Super-pure and commercial grade aluminium foil, etching chemicals, sodium hydroxide, nitric acid, and hydrochloric acid are the main raw materials needed in the process. Except super-pure aluminium foil, all the raw materials are indigenously available.

The major equipment required are: rectifier for etching, dc motor, reduction gear for dc motor, constant speed arrangement, centrifugal pump, contact roller, etched foil drier, silica immersion heater, rectifier for dc motor, deionizer unit, copper busbar, cathode mounting assembly, stainless steel tanks, mild steel tanks, aluminium tanks and polythene tank. All the items are either available indigenously or can be fabricated indigenously.

The total outlay for setting up a plant capable of producing 7·23 tonnes of plain foil per annum has been estimated at Rs 2·94 lakh. The cost of production has been estimated at Rs 74·85/kg.

The total capital investment for a plant to meet the captive requirement of its capacitor industry has been estimated at Rs 2·94 lakh, comprising Rs 59 500 as fixed capital on building, Rs 1·47 lakh as fixed capital on plant and Rs 87 000 as working capital.

The total investment for setting up a plant which produces the foil for consumption by capacitor producing units has been estimated at Rs 8·28 lakh, comprising a sum of Rs 71 000 on building, Rs 3·40 lakh on plant and Rs 4 16 500 as working capital.

Further particulars may be obtained from: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

CSIR SUPPORT TO RESEARCH

Completed Schemes

Studies in Galvanoluminescence

A phenomenon known as galvanoluminescence (also called glow-electrolysis) — a non-Faradaic process — is observed in the course of conventional electrolysis of aqueous electrolytes if the potential applied is sufficiently higher than the decomposition potential. It is characterized by the appearance of luminescence at one of the electrodes and other interesting features. The physical characteristics, general applicability and chemical effect of the process have been studied by Shri S. K. Sen Gupta, a CSIR research fellow, at the Department of Physical Chemistry, Indian Association for the Cultivation of Science, Calcutta (Oct. 1970 to Aug. 1972).

The phenomenon has been found to be a general one in the field of strong aqueous electrolytes, including acids, bases and salts. Though there is a strong preference for the luminescence to appear at the cathode, anode glow can also be developed under proper conditions. Galvanoluminescence is observed only if the potential applied is sufficiently high, and the result is seriously affected by temperature, electrolyte concentration and relative cathode-anode dimensions.

It has also been observed that the amount of the electrode gas from the glowing electrode always exceeds the Faradaic value and is a liberal mixture of hydrogen and oxygen. Though this is true for both cathode glow and anode glow, the departure from Faradaic value and the extent of co-liberation is more prominent in the case of cathode glow than in case of anode glow under otherwise indentical conditions. The extent of departure from Faradaic value and that of co-liberation of hydrogen and oxygen in an electrode gas are largely dependent upon intensity and area of luminescence. Also, during the process many other side reactions may occur depending upon the nature of the solution used.

Attempts have been made to extend the process to non-aqueous systems like alcohols and glycols. Ethyleneglycol has been found to be a suitable medium for the production of both cathode glow and anode glow with a variety of salts including soaps.

New Schemes

Chromatographic Studies on Metal Complexes

Chromatography is a powerful tool in the identification and separation of metal-biguanide and metal-amidinourea complexes. The usefulness of chromatography in the identification of mixed chelates has not so far been examined. In a new CSIR research scheme granted to him, Dr R. L. Dutta (principal investigator) of the Chemistry Department, University of Burdwan, Burdwan, proposes to identify mixed chelates by the use of paper chromatography, ion-exchange paper chromatography, and thin-layer chromatography.

Soil-borne Diseases of Onion in Madhya Pradesh

Onion (*Allium cepa* Linn.) is an important winter crop in Madhya Pradesh. During *rabi* of 1967-68 this crop was heavily damaged by pink-rot and basal rot near Ujjain and also in other districts of the state. A preliminary survey of onion fields was made and diseased materials were collected for isolation and study of pathogen(s). A few soil-borne fungi were found to be associated with these diseases.

In view of the growing damages and losses to the onion crop with soil-borne fungi in fields and storage, Dr S. K. Chauhan (principal investigator) of the School of Studies in Botany, Vikram University, Ujjain, proposes, in a new CSIR research scheme granted to him, to study the soil-borne diseases of onion in Madhya Pradesh. This will involve: (1) study of factors which influence the incidence of the disease; (2) survival of the pathogen(s) and the recurrence of the disease; (3) rhizosphere studies in relation to different cultivars of onion and disease development; and (4) isolation of antagonistic microorganisms against the pathogen(s) and investigation on the possibility of biological control. The results of the investigation are expected to lead to effective control measures.

PATENTS SEALED

123641: A process for uniform electrostatic charging of photoconductive plates for electrophotographic machines, P. C. Mahendru, D. C. Parashar, G. D. Sootha, D. Singh & N. Kumar—NPL, New Delhi.

124758: Improvement in or relating to mechanical integrator, B. M. Sen, T. R. G. Rao & S. N. Ray—CMERI, Durgapur.

125374: Water sprayer, S. Ramachandra & S. L. Raj—MERADO, Madras (CMERI, Durgapur).

125604: Improvements in or relating to the electrochemical production of iron powder from mill scale produced during rolling operations in steel rolling mills or materials of similar nature, H. V. K. Udupa, P. V. Vasudeva Rao & R. Vijayavalli—CECRI, Karaikudi.

Contents List of Soviet Scientific Periodicals

The Russian Science Information Centre of the Indian National Scientific Documentation Centre, New Delhi, has started issuing the *Contents List of Soviet Scientific Periodicals* in a printed form with a new format from September 1972.

Periodicals covered in the contents list are arranged alphabetically by their transliterated titles and under each title are reproduced original contents pages, excepting a few cases. Subjects list of periodicals included in the issue is also provided at the end.

At present the contents list covers about 70 titles pertaining to various scientific disciplines. The coverage will be increased from early 1973.

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Council of Scientific & Industrial Research Annual Report : 1971

The annual report of the Council of Scientific & Industrial Research for the year 1971, 30th in the series, has been published. The introduction to the 177-page report (royal 8vo) by the Director General, Scientific & Industrial Research, outlines some of the major structural changes being implemented in CSIR. For instance, the activities of the Council will be concerned with industrial/applied research and development projects, together with fundamental research in areas where it is relevant to these programmes. The CSIR laboratories and industrial research associations have been classified into six groups (Chemical Sciences, Physical and Earth Sciences, Engineering Sciences, Biological Sciences, Fibres, and Scientific Information) with a coordination council for each of them with a view to achieving optimum inter-laboratory collaboration.

The research programmes of the laboratories continued to be project-oriented towards the industrial advancement of the country. As many as 2055 research projects, including 324 projects either sponsored by or taken up at the instance of industry, were under investigation in the Council's laboratories during the year under review. Of these, 1804 were applied research projects and 251 basic research projects. Work on 443 projects was completed.

A brief account of selected items of work of the laboratories is given in the following paragraphs under some broad areas of work.

Physics, Electronics and Earth Sciences

High permeability ferrites (permeability range 1500-3000), extensively used in telecommunication and TV equipment and imported presently, have been produced at the National Pysical Laboratory (NPL), New Delhi, starting from manganese-zinc ferrites. To meet the demand from the Indian Telepone Industries Ltd and Bharat Electronics Ltd, Bangalore, the laboratory is taking up production of these ferrites on 200 kg/month scale. Another important achievement of NPL relates to the development of a process for the production of carbon microphonic granules used in telephone receivers. These granules are imported to the extent of 500 kg/annum.

Following the development of TV receivers, a transistorized TV receiver using 12-inch picture tube has been developed by the Central Electronics Engineering Research Institute (CEERI), Pilani. TV components like deflection coil, linearity coil, electronic high tension transformer and valve base, which are presently imported, have also been developed. Special purpose vacuum tubes, used in radar systems and other military equipment, are being designed and developed by CEERI. One such vacuum tube, viz. magnetron (500 kW), has been developed, and is being produced on a batch scale to meet user requirements.

CSIR BASIC DATA : 1971

Establishments	34
Research Committees	13
Industrial Research Associations	9
Research Centres	2
Research Schemes	622
Emeritus Scientists	12
Retired Scientists	76
Pool Scientists	397
Research Fellowships	2982
Scientific & Technical Staff	9811
Administrative Staff	2618
Research Papers Published (Laboratories)	1049
Patents Filed	
India	163
Foreign Countries	18
Publications	84
Processes Released to Industry	126
Processes Utilized by Industry	35
Total Processes in Production	229
Revised Budget for 1971-72	
Capital	Rs 795.150 lakh
Recurring	Rs 1624.280 lakh

The Central Scientific Instruments Organization, Chandigarh, has developed: (i) a 12-digit electronic desk calculator capable of performing addition, subtraction, multiplication, and division; (ii) a differential output operational amplifier with a high common mode rejection ratio, without cross-over distortion, and differential input and output; and (iii) a temperature controller unit suitable for studying polymer reactions.

A significant contribution in the field of geophysics is the preparation of the seismicity map for Alpide belt–Sunda Arc (extending from Philippines to Central Europe through the Himalayas) by the National Geophysical Research Institute, Hyderabad. This map gives quantitative indication of the various levels of seismic activity in the area, and would be useful in the design of economic earthquake-proof buildings, dams and other structures in the region.

Chemical Technology

A commercial scale process for producing the industrial solvents carbon tetrachloride and chloroform, by the chlorination of waste methane, is being developed jointly by the National Chemical Laboratory (NCL), Poona, and Standard Mills Ltd, Bombay. Based on NCL designs, a 300 tonnes/annum plant, using a fluidized-bed reactor, has been successfully commissioned at the factory site. The data gathered from this plant will be used for setting up a commercial plant of 3000 tonnes/annum capacity. On behalf of Dey-Se-Chem, Calcutta, a two-step process for the production of *p*-nitroacetophenone, an important intermediate in the manufacture of chloramphenicol, has been developed by NCL, starting from ethylbenzene. The estimated requirements of the chemical are 75 tonnes/annum, valued at Rs 75 lakh. Another important achievement of NCL is the development of a process for the production of ethylenediamine, starting from ethylene dichloride and liquor ammonia on 225 g/hr scale. Ethylenediamine is a versatile chemical which finds wide applications — textile lubricants; stabilizer for rubber latex; rubber accelerators; corrosion inhibitor in antifreeze solutions; dyes; solvent for albumin and fibrin; etc. The demand for ethylenediamine by 1973-74 is estimated at 1000 tonnes/annum, valued at about Rs 1 crore. The process is being offered to industry on a turnkey basis through a firm of project engineers.

A corrosion inhibitor for steel automobile radiators has been developed by the Central Electrochemical Research Institute (CECRI), Karaikudi. It eliminates the use of brass and other copper alloys for the manufacture of radiators, and hence leads to saving in foreign exchange. The inhibitor also protects the corrosion of brass. The know-how for the fabrication of cadmium sulphide photoconductive cells using indigenous components has been developed by CECRI. The cells are comparable to imported cells in performance. A process for the preparation of iron powder by electrolytic reduction of millscale (a waste product of sheet rolling, wire drawing and rod drawing industries) has been developed by CECRI. This leads not only to the utilization of the waste material but has the potential of saving foreign exchange involved in the import of iron powder used for powder metallurgical purposes.

Anti-corrosive paints for painting ship bottoms have been developed by the Regional Research Laboratory (RRL), Hyderabad, using indigenous materials like cashewnut shell liquid vehicle (replacing imported phenols), barium phosphate (instead of imported basic lead sulphate) and anti-fouling pigments. These paints have been found to be satisfactory in service trials carried out by the Shipping Corporation of India, and indicate the possibility of eliminating the imports of such paints amounting to about a lakh litres/annum. A catalyst for converting benzene to cyclohexane has been developed by RRL, Hyderabad. Cyclohexane is an important intermediate for the manufacture of caprolactam, which in turn is the starting material for the manufacture of synthetic fibres, coatings, plastics, and nylon tyre cords.

A process for the production of matrix boards, suitable for making stereotype plates used for printing purposes, has been developed by the Regional Research Laboratory (RRL), Jorhat, using indigenous raw materials.

At the instance of Madras Refineries Ltd, a test rig for assessing the lubricity of aviation turbine fuels has been fabricated by the Indian Institute of Petroleum, Dehra Dun.

Based on the processes developed by the Central Salt & Marine Chemicals Research Institute, Bhavnagar, commercial production of (i) potassium schoenite (potassium-magnesium fertilizer) from mixed salt, and (ii) bromine from bitterns, was started by parties at Tuticorin and Navlakhi (Gujarat) respectively.

Fuel Technology and Metallurgy

Quartzite-incorporated briquettes from non-coking coals produced by the Central Fuel Research Institute (CFRI), Dhanbad, have been found suitable for use in the manufacture of ferro-silicon and ferro-alloys. Of considerable significance to hydrogenation industries, like vanaspati manufacturers, is the discovery of siderite ore (iron carbonate) in Gujarat, which has been found to be a good substitute for the imported Spanish spathic iron ore for producing hydrogen by the steam-iron reaction. Under a project taken up at the instance of ECAFE, the institute has successfully produced formed coke from Korean anthracite and Korean asphalt binder; the briquettes can be used as a cupola fuel and as reductant in electrothermal processes. Some of the other major projects investigated by CFRI include: (i) study of supply of coal for coking in the coke ovens of Bokaro Steel Ltd, (ii) selection of coking blend for Rourkela and Durgapur Steel Plants; and (iii) feasibility study of Monidih Washery Project, Kargali Washery and a technical probe on slurry recovery in Kargali Washery on behalf of the National Coal Development Corporation.

Studies on the beneficiation and agglomeration of iron ores from Asswan (Egypt), Bailadila, Dalli-Rajhara, and Bolani have been carried out by the National Metallurgical Laboratory (NML), Jamshedpur. A flow-sheet and equipment details of a plant for producing pellets of iron ore fines from the deposit No. 14 of Bailadila have been provided to the National Mineral Development Corporation. A low-grade molybdenite ore from Madurai (Tamil Nadu) has been beneficiated successfully to marketable grade by raising the molybdenum content from 0.04-0.17% to 43.0-54.5% with a molybdenum recovery of 71%. Processes have been developed by NML for the pre-reduction of ores and pellets, and for the production of sponge iron. The prototype plant for producing magnesium metal (initial capacity, 200 tonnes/annum), has been set up at the laboratory. The facility can also be utilized for producing calcium, which is also imported presently.

The Regional Research Laboratory (RRL), Bhubaneswar, has developed, on a laboratory scale, a hydrometallurgical process for the extraction of nickel and cobalt.

Drugs, Pharmaceuticals, Experimental Medicine and Toxicology

A new contraceptive device, named Centsquare, has been developed by the Central Drug Research Institute (CDRI), Lucknow. This is produced from indigenous raw materials; is free from side-effects; easy to use and readily acceptable; and has a very low rate of failure compared to other methods of contraception in vogue. Another contribution of this laboratory, of interest to the pharmaceuticals industry, is the production of nicotinamide, a nutritional factor and an ingredient of vitamin B complex formulations, using indigenous chemicals. The preparation of the starting material nicotinic acid from β-picoline sulphate by nitric acid oxidation has also been standardized on 1 kg scale. A new tranquillosedative, under the name Centazolone, developed by CDRI, has been cleared by the Drug Controller for clinical trials. The drug is safe up to a dose of 160 mg as against an anticipated dose of 10-20 mg.

Following up its success in the isolation of the anti-leucoderma drug xanthotoxin from *Ammi majus* seeds and *Heracleum candicans* roots, the Regional Research Laboratory, Jammu, has not only scaled up the processes but has started commercial production of the drug from the first source at the CIMPO drug factory, Jammu.

The possibility of developing an early diagnostic test for cancer on the basis of the relative levels of glutamine-amino hydrolase and glutamine-amino transferase in the blood has been verified by the Indian Institute of Experimental Medicine, Calcutta.

Studies carried out by the Industrial Toxicology Research Centre, Lucknow, on the lung disease in farmers handling mouldy hay have shown that the disease is chiefly caused by hay dust and that the fungus merely alters the condition in the early stages of the disease.

Pollution Problems

At the instance of the Bombay Municipal Corporation, the Central Public Health Engineering Research Institute (CPHERI), Nagpur, and the National Institute of Oceanography (NIO), Panaji, have taken up investigations for planning outfalls into the sea for sewage and industrial effluents in the Greater Bombay region. Four outfalls on the west coast of Manori, Bandra, Worli and Malabar point were suggested. At the instance of the Tanzania Government, CPHERI is rendering technical advice in regard to the defluoridation of water in the Arusha region. The medium Defluoron-2 developed by the institute is being used for the purpose.

Glass, Ceramics and Refractories

Ceramic filter candles for Katadyn type pocket water filter pump, used by defence personnel in remote and difficult areas, have been developed by the Central Glass & Ceramic Research Institute (CGCRI), Calcutta, from indigenous materials. The candles give a high rate of filtration comparable to that obtained in imported candles. The filtered water, obtained even at the high rate of filtration, could be made free from bacteria causing cholera, typhoid and dysentery by a special chemical treatment. Investigations carried out by CGCRI have shown that a combination of cerium oxide and selenium, effecting 50% reduction in the consumption of the imported metal selenium, can be used for decolorization of glass; also, other imported chemicals like arsenic and sodium nitrate can be dispensed with. The special clays required for making bloating type refractories (used as ladle bricks, nozzles and stopper heads in casting steel) need no longer be imported as CGCRI has developed synthetic bloating type refractories by blending together commercial fire clay, Gangetic silt, fluxes and bloating agents.

Leather Technology

An achievement in the field of leather technology from the point of view of export promotion of leather goods and finished leather is the fungicide-treated paper developed by the Central Leather Research Institute, Madras, which can protect leather goods from mildew growth for periods up to 6 months. A fungicidal emulsion, which can be applied to leather either during the process of manufacture or at the stage of manufacture of footwear and leather goods, has also been developed by CLRI. Both the fungicidal paper and emulsion are cheap products which could be profitably used at the cottage industry level. Leathers resembling velvets and possessing textile-like finishes and designs can be produced as a result of a new technique of screen or block colour printing of leathers. The printed leathers are light-fast and washable. The technique could lead to profitable utilization of rejected goat and sheep leather.

Food Technology

Investigations being carried out by the Central Food Technological Research Institute (CFTRI), Mysore, on the production of acceptable edible sesame flour and its fortification with essential amino acids could go a long way in fighting protein malnutrition. The institute has shown, for instance, that the protein efficiency ratio (1.8) and net protein utilization (67) of the edible flour could be raised by supplementation with *l*-lysine hydrochloride (1.25%) to 2.9 and 89 respectively. Dehulled sesame seed finds use in confectionery and the defatted flour in weaning foods as a rich source of sulphur-containing amino acids. Utilization of linseed meal is hampered due to the presence of mucilage, fibre and anti-nutritional factors. Investigations carried out by CFTRI have shown that mucilage can be removed by soaking the seed in an acid followed by washing, and that flaking and screening eliminate nearly 80% of husk. The meal fraction is defatted by screw pressing and solvent extraction to obtain a product containing 50% protein. Anti-nutritional factors are inactivated by autoclaving the meal. Feeding trials on chicks using this meal at 25% protein level have given good growth response.

Aromatic and Medicinal Plant Products

Working out economic methods for the isolation of essential oils from essential oil bearing plants is engaging the attention of some of the CSIR laboratories like NBG, CIMPO, RRL, Bhubaneswar and RRL, Jorhat. A steam distillation unit for isolating the essential oil from lemongrass oil has been fabricated by RRL, Bhubaneswar. Oil of lemongrass is an important essential oil used in perfumery industry. An improved apparatus for the distillation of *attars* and rose water was fabricated by the National Botanic Gardens (NBG), Lucknow.

The Central Indian Medicinal Plants Organization (CIMPO), Lucknow, has successfully introduced *Ocimum basilicum* (French basil) at Lucknow, Haldwani and Bangalore. The oil of citronella (Java) has been produced economically at Bangalore under irrigated (yield, 150 kg/ha) and rain-fed conditions (yield, 50 kg/ha).

Based on the know-how and planting materials supplied by RRL, Jorhat, 33 tea gardens in Assam are cultivating citronella grass, and supplying oil to consumers. An experimental farm for the cultivation of medicinal and essential oil bearing plants has been set up in Nagaland.

The improvement of amaranths, cultivated for grain and as pot herbs, is being studied by NBG. The amaranths are a rich source of vitamin A and contain a substantial amount of leaf protein. A new grain amaranth, combining disease resistance, hardiness and the early maturing of its wild parent *A. hybridus* with the white seeds of *A. hypochondriacus*, has been developed. A new type of *Amaranthus caudatus* with erect, beaded and red inflorescence has been developed.

Civil Engineering

Modernization of the methods of design and construction of reinforced concrete structures by bringing them in line with current practices in advanced countries would effect considerable savings in steel and cement. Towards this end the Structural Engineering Research Centre (SERC), Roorkee, has prepared a revised draft of the unified code of practice for reinforced and prestressed concrete, incorporating the recommendations of CEB-FIP. Development of a large panel prefabrication system suitable for the Madras city, using locally available materials and incorporating the techniques developed at SERC, has been taken up by the regional centre of this laboratory. It was found that large panel fabrication on the basis of on-site prefabrication can be carried out without resorting to large-scale, centralized factory production. Simple jointing techniques suitable for 4- to 5-storey constructions have been developed.

A detailed study of the Bokaro Steel City was undertaken by the Central Building Research Institute (CBRI), Rookee, for predicting the densities and development patterns for future growth. The planning practices of the city have been evaluated. Under-reamed pile foundation has been found to be suitable for microwave antenna towers.

Some of the important projects investigated by the Central Road Research Institute, New Delhi, are; (1) development of appropriate serviceability indices for pavements under Indian conditions; (2) design and construction of prestressed concrete pavements; (3) rating of masonry arch bridges; and (4) development of photo-interpretation techniques for the location of hidden road construction materials. Construction of a marine drive from Konarak to Puri, road development projects in various states, and comprehensive traffic and transportation planning of Greater Delhi and Greater Bangalore are some of the major projects investigated by CRRI.

Mechanical Engineering

A significant achievement in the field of mechanical engineering is the design and development of a 100-hp (8000 rpm) hydraulic dynamometer by the Central Mechanical Engineering Research Institute (CMERI), Durgapur; a prototype will be fabricated by the collaborating firm. A tungsten inert gas (TIG) cutting torch and necessary auxiliary equipment have been designed and developed by CMERI. Trials on the prototype have shown that it can successfully cut 25-mm thick steel and 37-mm thick aluminium plates. Metal cutting by this technique is a comparatively recent technology, and the technique is 8 to 10 times more efficient than conventional techniques using hacksaw or bandsaw.

At the instance of the Director General of Mines and Safety, the Central Mining Research Station (CMRS), Dhanbad, carried out studies for developing suitable lubricants needed in the manufacture and during servicing of winding ropes. Two indigenously developed lubricants were found satisfactory.

A high pressure laboratory for evaluating the behaviour of materials under conditions of high pressures and temperatures and for the production of materials has been commissioned at the National Aeronautical Laboratory (NAL), Bangalore. A 1000-tonne hydraulic press, comparable in quality to similar equipment made abroad, has been fabricated using entirely indigenous components. A high pressure X-ray diamond anvil camera capable of producing 5×10^6 lb/in.^{2} pressure has also been constructed.

Industrial Research Associations

A significant achievement of the Ahmedabad Textile Industry's Research Association (ATIRA), Ahmedabad, is the chemical modification of tamarind kernel powder for application in cotton warp sizing in place of maize starch; this is expected to bring down the sizing costs by 50%.

Production of nylon parachute cloth from indigenous nylon yarn and weaving of high density polythene split yarn on indigenous automatic loom by suitable modification of loom are the highlights of work of the Silk and Art Silk Mills' Research Association (SASMIRA), Bombay. A special type of semi-elastic bandage cloth developed by the South India Textile Research Association, Coimbatore, using the slack mercerization process, is specially useful for pressure dressing.

A novel and simple method of improving the strength of cotton yarns by swelling treatments has been worked out by the Bombay Textile Research Association (BTRA), Bombay. The Wool Research Association (WRA), Bombay, has developed a process for permanent pleating of all-wool trousers, rendering the pleats resistant to deformation by accidental wetting or due to high humidity. The process, standardized on a pilot plant scale, has been handed over to industry for implementation. Another process deveped by WRA is concerned with the manufacture of wash-and-wear polyesters/viscose garments. A 20-spindle frame based on double apron drafting system for spinning jute has been designed and developed by the Indian Jute Industries' Research Association, Calcutta, in collaboration with a firm. It is superior to the conventional frame both in regard to productivity and quality of yarn.

A resin adhesive for plywood using multivalent phenol, a byproduct from the Neyveli Lignite Corporation, has been developed by the Indian Plywood Industries Research Institute, Bangalore. Formulations of urea-formaldehyde and phenol-formaldehyde resin adhesives suitable for the pre-pressing operation in plywood manufacture were also evolved.

The Barbora continuous leaf conditioner for conditioning withered tea leaf for C.T.C. tea manufacture, designed and developed by the Toklai Experimental Station of the Tea Research Association, went into commercial production.

Byproduct gypsum from fertilizer factories, containing more than 90% of $CaSO_4 . 2H_2O$, could be utilized as a set-controller in the manufacture of portland cement. Investigations carried out at the Cement Research

Institute, New Delhi, have shown that for a satisfactory retardation of the cement clinker, byproduct gypsum corresponding to at least 1·75% SO_3 level is required as against 1.2% SO_3 level for natural gypsum. Use of byproduct gypsum, instead of natural gypsum, as a set-retarder resulted in slightly higher compressive strengths at 1, 3 and 7 days.

Dissemination of Scientific Information

The encyclopaedic publication the Wealth of India : Industrial Products, Part VII, covering the alphabetical sequence Pl to Sh, has been brought out by the Publications & Information Directorate, New Delhi. The first volume of the Wealth of India : Raw Materials (Hindi series), under the title *Bharat ki Sampada : Prakratik Padarth*, covering all the vowels in the Devanagari script has been brought out. Two botanical monographs, viz. Proteaceae and Pinus, have also been brought out.

The publication of cover-to-cover translation of Dopovidy (Transactions) of the Academy of Sciences of the Ukrainian SSR, Ser. A (physics, technical and mathematical science); and Ser. B (geology, geophysics, chemistry and biology) was taken up by the Indian National Scientific Documentation Centre, New Delhi, and two issues of the translation were brought out.

Biological Industries : Group Discussion at IIEM, Calcutta

As part of the programme of the silver jubilee celebrations of Indian independence, the Indian Institute of Experimental Medicine (IIEM), Calcutta, had organized a group discussion on biological industries on 26 August 1972 at which representatives of a number of industries concerned with the production of biologicals and a large number of research workers took part.

Dr A.N. Bose, Director, Bengal Immunity Research Institute, Calcutta, representing the Bengal Immunity Co. Ltd, gave an account of the production of sera and vaccines, especially diptheria and tetanus antitoxins with which the firm is concerned. He stressed the need to develop better media to improve the yield of toxins, especially diptheria toxin, so that they could cope with the increasing demand for triple antigen. Another problem was the maintenance of horses in a condition of responsiveness to hyperimmunization for longer periods.

The production of penicillin at the Standard Pharmaceuticals Ltd, Calcutta, based on the technical know-how from Squibb, was dealt with by Dr D. Chakravarty of the firm. Among the problems he suggested for investigation were: (i) development of mutant strains of the fungus possessing greater resistance to higher temperature and changes in *p*H, and (ii) finding cheaper substitutes for media components like dextrose/sucrose and corn steep liquor. He also made a suggestion that a fermentation unit be set up at IIEM to study these problems and also to produce such products as digestive enzymes, lysine, and citric acid. Since there were three production units in this area dependent on fermentation technology, their co-operation and assistance would be available to the institute.

The need for the safety of parenterals has assumed special significance because of their increased use. Two of the problems encountered in the manufacture of parenteral products, as pointed out by Shri Amar Das of Stadmed Private Ltd, Calcutta, are to ensure sterility and freedom from pyrogen. In spite of the stringent precautions, one batch in every 30 on an average was found to fail in the sterility test in his experience. On re-sterilization these passed the sterility tests. Such failures of sterilization could only be due to an extremely resistant spore of a non-pathogenic type of bacteria. As regards pyrogen, he posed the following questions: (1) Could deionizing resins be used to remove pyrogen from the final products without loss of active material ? (2) Would it be proper to use the parenteral administration solutions rendered pyrogen-free by storage in a glass vessel for 3-6 months, taking advantage of the tendency of pyrogenic materials to get strongly adsorbed to glass surfaces in cold storage? A straightforward method for the detection of antigens, according to him, was necessary.

Dr S.L. Mukerjee, representing Organon (India) Ltd, Calcutta, said that his firm had the know-how for the production of all the steroid hormones—anabolic, estrogenic, etc. Their basic problem was that of proper supply of *Dioscorea* yams, or diosgenin. The pioneering work of Prof. R.N. Chakravarti on the survey of Indian *Dioscoreas* has led to the establishment of *Discorea prazeri* and *Dioscorea deltoidea* as the most important sources of diosgenin in India. With the increasing production of steroidal drugs, the price of of the raw material was shooting up, as the cultivation of the yams was not carried out properly. There was need for research on the proper conditions for cultivation, if massive cultivation of the yams were to be taken up under optimum conditions. As regards the development of new products, it was important to test the biological activity of all intermediates during synthesis of biologically active products, and such tests as well as a custom process service consisting of the preparation of biological and chemical reagents required by industry might be undertaken by the institute. He also stressed the need for developing fermentation technology at the institute.

Shri R.N. Ghatak, of The Indian Yeast Co. Ltd, said that the main problem facing the yeast industry was in regard to molasses. In India only sugarcane molasses are available in place of beet molasses used in western countries. As a result, the yield in India was only 50% as against 80% in western countries. A similar difficulty was experienced in the production of citric acid by fermentation.

Representing Tata Fison Industries Ltd, Konnagar, Shri A. K. Bhattacharya gave an account of the manufacture of dextran using *Leuconostock mesenteroides*. To manufacture the clinical type of dextran the degraded dextran has to be fractionated with organic solvents, a procedure that does not usually yield a homogeneous fraction. For obtaining fractions of the same molecular weight, the use of molecular sieves was a more precise technique and this is an area in which there is scope for research and development. Investigations of the synthesis of dextran, using cell-free enzyme extract as an alternative to fermentation, could also be taken up. Adequate attention should also be given to the technique of ultrasonic depolymerization of residual dextran for recycling.

The East India Pharmaceutical Works Ltd, Calcutta, are interested in the production of digestive enzymes and *l*-lysine, as revealed by Dr A. Kundu of the firm. In many places such work was not progressing properly due to the non-availability of proper microbial strains. He suggested that research institutions like IIEM could maintain proper strains along with a catalogue of their properties for the use of other research institutes and the industry.

Prof. Chakravarti, Director, IIEM, stated that the institute would have a new division on biochemical engineering with provision for the development of fermentation technology. There was also a proposal for setting up large fermenters at Mysore and Lucknow under CSIR. Job work for chemical and biological preparations could be undertaken at IIEM in special cases, but not as a routine; to meet the latter needs there was scope for the growth of small scale industries.

In regard to the basis of individual variations in susceptibility to hyperimmunization, Prof. Chakravarti suggested that it was necessary to study the fundamental basis of such variation and the factors leading to hyperimmunization. Search for more potent sera and vaccines had to be continually pursued. A project on the experimental cultivation of *D. deltoidea* was being jointly pursued by ICAR, CSIR and the Ford Foundation. Cultivation of *D. deltoidea* as well as *D. prazeri* was also in progress under a joint project of CIMPO, Lucknow, RRL, Jammu, and IIEM. With regard to yeast, he pointed out the need for producing yeast of suitable grade for the production of ergosterol. In a reference to the use of deionizing resins for removing pyrogens, Prof. Chakravarti expressed the view that charcoal would be equally satisfactory, although in some cases better results might be obtained if suitable grades of resin are used. There should be no objection to using parenteral solutions made pyrogen-free by storage in glass containers in the cold, but this should have the approval of the proper authorities.

In conclusion, Prof. Chakravarti expressed the hope that the contact made in the course of this discussion would go a long way in promoting the proper development of biological industries.

PROCESSES & PRODUCTS READY FOR COMMERCIAL UTILIZATION

Glyceryl Guaiacolate

Glyceryl guaiacolate is mainly used as an expectorant in cough remedies and in certain cases as an intestinal antiseptic. At present there is no indigenous production of this drug and the entire requirement, estimated at about 2 tonnes/annum, is being met by imports costing about Rs 1.5 lakh.

The National Chemical Laboratory (NCL), Poona, has developed a process for the preparation of glyceryl guaiacolate. The process consists in (i) preparing guaiacol by diazotization of *o*-anisidine followed by hydrolysis, and (ii) condensing sodium salt of guaiacol with glyceryl chloride (prepared from epichlorhydrin) to produce glyceryl guaiacolate. The process has been standardized on 66 g/batch scale. The product has been tested by a few pharmaceutical firms and found to conform to the National Formulary NF (XIII).

o-Anisidine,. sodium nitrite, sulphuric acid, benzene and epichlorhydrin are the main raw materials required for the manufacture of glyceryl guaiacolate. Of these, epichlorhydrin and sodium nitrite will have to be imported.

Reactor, distillation vessel, separator, plastic bucket or wooden vat are the major items of plant and equipment. All these can be fabricated indigenously. For a small scale plant, the entire equipment could be of glass.

The capital outlay for a plant capable of producing 2 tonnes/annum of the product, assumed as the economic plant capacity by NCL, has been estimated at Rs 7.4 lakh (Rs 3.30 lakh on plant and building, and Rs 4.10 lakh as working capital). The cost of production comes to Rs 65/kg.

Further particulars may be obtained from : The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

Oxalic Acid from Saw Dust

Oxalic acid is an important chemical used in textile industry and metal polishes. The conventional method of preparing oxalic acid, viz. oxidation of cellulosic materials and carbohydrates with nitric acid, has now been replaced by synthetic methods in the advanced countries. In India, some industries are making oxalic acid from sugar, which is a very costly raw material. The requirement of oxalic acid is estimated at about 400 tonnes/annum.

With a view to conserving sugar and utilizing an inexpensive raw material, the Regional Research Laboratory (RRL), Jorhat, has developed a process for the manufacture of oxalic acid from saw dust, a cheap and abundantly available raw material. With the availability of oxalic acid at economic rates, there is a possibility of exporting this chemical also. The product prepared by the laboratory has been tested and found to conform to the required standards, and is acceptable to industry.

The process essentially consists in the oxidation of saw dust by nitric acid, filtration of acid digest, and crystallization of oxalic acid. The nitric acid can be recovered and re-used. The process has been studied on an experimental unit (capacity, 20-25 kg/day).

The main raw materials required for the manufacture of oxalic acid are saw dust, nitric acid, catalyst and caustic soda, and only the catalyst requires to be imported.

Reaction kettle, gas cooler, absorption tube, Raschig rings, centrifuge and batch dryer are the main items of the plant and equipment. All these can be fabricated indigenously.

The total capital outlay for a plant capable of producing one tonne of oxalic acid per day has been estimated at Rs 14 lakh (Rs 9.5 lakh on plant, machinery and building, and Rs 4.5 lakh as working capital). The cost of production comes to Rs 2.85/kg.

Further particulars may be obtained from : The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

CSIR SUPPORT TO RESEARCH

Completed Schemes

Absorption and Metabolism of Carotenoids and Vitamin A in Rats and Chickens

A comparative study of absorption and metabolism of carotenoids and vitamin A in chickens and rats has been made by Shri S.N. Mathur, a CSIR research fellow, who worked at the Department of Biochemistry, Indian Institute of Science, Bangalore from Sep. 1969 to Dec. 1971. The metabolism of vitamin A in the developing chick embryo has also been studied. The studies were made under the direction of Prof. J. Ganguly of the department.

Absorption of vitamin A in chickens and rats

Extensive work carried out at this laboratory over several years has shown that during absorption in the living rat, the dietary retinyl acetate undergoes complete hydrolysis before retinol is admitted into the mucosal cell. It has also been shown that following feeding of retinyl acetate, only traces of it could be detected ir the mucosa but none in the intestin muscles and other tissues of ra mostly higher esters were presen the mucosa and liver of the Later on, fractionation of the m h sal cell into the brush border, le- border-free particles and ral free supernatant fractions a to administration of retinyl a the rats, showed that while tra the acetate could be detect was brush border fraction, where found in the rest of th l were only higher esters of eported present. It was furt mucosal that on fractionation nuclear, cell into the brush bo and nonmitochondrial micro procedure particulate fractions the brush of Clarke and Po n accounts border + nuclear the retinyl for more than 5 ity of the acetate hydrola observations whole mucosa. hat in the living rat the retin l cell without led to the concl are not admitted into the prior hydrolysis and hat the terminal hydrolysis of the aceta takes place on the outer surface o he mucosal cell.

The question now a ose whether the ester is unable to e er the mucosal cell unchanged, or whether the active retinyl acetate hydrolase of the brush border rapid hydrolyzes it and thereby does n t allow it to enter the cell in the u hanged state. To answer this estion, the approach adopted was to reduce the activity of the mucos hydrolase to a low level, without e ecting appreciable changes in the morphology of the cell, and to study the possibility of entry of the acetate into the cell under ch conditions It was found that e activity of retinyl ester hydr ase of both everted sacs and mu al homogenates of rat intestin was markedly less at 0°C, as c pared to that at 37°C. Everted stinal sacs were incubated at 0°C 30 min with retinol or retinyl etate in the medium, after which ey were exhaustively washed with cold saline till the washings were free of vitamin A. Reincubation of such sacs for another 30 min at different temperatures led to the appearance of higher esters of retinol, which progressively increased with increase in the temperature of reincubation. When the mucosal cells from sacs, which were incubated at 0°C with retinyl acetate and similarly washed, were fractionated into the brush border, brush border-free particles and particle-free supernatant, or total particles and particle-free supernatant, or epithelial cell-ghosts and supernatant fractions, significant amounts of the acetate were found in all the supernatant fractions and also in the brush border-free particles fraction, thereby suggesting that at low temperature, where the activity of the retinyl ester hydrolase of the mucosa is reduced to a low level, significant amounts of the acetate can enter the mucosal cell without prior hydrolysis.

In the above experiments the activity of the acetate hydrolase of the whole mucosal cell is lowered at low temperatures, and, therefore, it is not possible to conclude whether the retinyl acetate is hydrolyzed on the surface of the cell by the brush border enzyme or whether it is hydrolyzed within the cell in the living animal. Hence, during the present work the intracellular distribution of retinyl acetate hydrolase in rat mucosal cell has been investigated. A comparative study of the mode of absorption of retinyl acetate in rats and chickens has also been made. This comparative study is of interest because, in contrast to the observations in the rat where acetate is believed to be hydrolyzed before entry into the mucosal cell, Brackkan [*Int. Zschr. Vitamint.*, **33** (1963), 293] claimed to have found retinyl acetate in the blood of chicks, after feeding them the acetate. He also observed similar absorption curves for retinol and retinyl acetate in chicks and concluded that in chicks a part of the dietary acetate is absorbed as such without prior hydrolysis.

In earlier work carried out in this laboratory with rats the brush border was isolated by adopting the procedure of Miller and Crane [*Biochim. Biophys. Acta*, **52** (1961), 293]. But this procedure proved unsatisfactory for the isolation of brush border from chicken mucosa, because it was noticed that during the isolation of brush border, the *p*H of the medium drops below 6·6, whereas satisfactory *p*H should be around 7·4. It was however found that if 5 *mM* EDTA/0·02 *M* Tris buffer of *p*H 7.4 is used instead of 5 *mM* EDTA of *p*H 7·4, a highly satisfactory preparation of chicken intestinal brush border could be obtained. The brush border preparation was found satisfactory when viewed under phase contrast microscope and also from the investigations on the distribution of marker enzymes, namely invertase and alkaline phosphatase.

On fractionation of rat and chicken mucosa into the brush border and the rest of the cell, the chicken brush border contained only 27% of the retinyl acetate hydrolase activity of the whole mucosa, while the corresponding value for the rat was 19·4%. In both the species the specific activity of the hydrolase was higher in the brush border-free particle fraction as compared to the brush border fraction, which strongly indicated that the hydrolase is not a typical brush border enzyme. With successive steps of purification of the chicken and rat brush border, the specific activities of the brush border marker enzymes, viz. invertase and alkaline phosphatase, increased while those of the retinyl acetate hydrolase decreased.

In both the species, following feeding of 9 μmol of retinyl acetate in 0·5 ml of oil, the acetate was extensively hydrolyzed in the intestinal lumen and 84-87% of the total ester was present as the lower ester. But in the mucosa the lower ester was only 26% of the total esters. No lower ester could be demonstrated in the intestinal muscles, blood and liver of rats and chickens.

The following are the tentative conclusions of the study:

(1) The retinyl acetate hydrolase is not a typical brush border enzyme in both species.

(2) A similar mechanism operates in the absorption of the acetate in both species.

(3) A part of the fed acetate may enter the mucosal cell intact and the terminal hydrolysis of the acetate probably takes place intracellularly.

Metabolism of vitamin A in developing chick embryo

Vitamin A is required by chick embryo for its growth and differentiation and it derives its supply from the vitamin A deposited in the yolk by the hen. It is interesting that the embryo shows an absolute requirement for vitamin A at very early stages of development. Therefore, even at such early stages of development the embryo should elaborate enzymes required for vitamin A metabolism. But there is no information as to how the embryo utilizes the vitamin A compounds and also as to how the enzymes involved in their metabolism are elaborated in the developing embryo. In the present work the development of retinyl ester hydrolase in the liver, intestine and pancreas of the embryo from the 8th day of incubation to hatching was studied. It was found that the total hydrolase activity of the liver and intestine, per embryo, increased from the day 8th of incubation till the day of hatching, with very little change in the specific activity. In the pancreas, a weak hydrolase activity towards retinyl acetate and palmitate was present till the 18th day of incubation. Thereafter there was a sudden and big increase in the activity between the 18th and 19th day, which coincided with the rapid proliferation of the pancreas after which it remained constant till the day of hatching.

Vacuum Measurement and Leak Detection Techniques : Symposium

A symposium on Vacuum Measurement and Leak Detection Techniques will be held on 27 and 28 February 1973 at the National Physical Laboratory, New Delhi. Research workers, and manufacturers and users of vaccum technique are expected to attend the symposium, which will deal with problems concerned with the production, indigenous availability of materials and equipment, and methods of standardization. Panel discussions to evaluate the problems facing these particular fields in the country will also be held. The symposium will also include lectures by experts.

Abstracts and full papers should be sent by 30 November 1972 and 1 January 1973 respectively. Further information may be obtained from : The Director, National Physical Laboratory, Hillside Road, New Delhi 12.

Refresher Course in Surface Coatings

A refresher course in Surface Coatings was held at the Regional Research Laboratory, Hyderabad, during 20-30 September 1972 under the auspices of the Southern Zonal Branch of the Oil Technologists' Association of India. The course was attended by some 70 participants from industries, universities and research laboratories. Twenty-five lectures by experts from industries, universities and research institutions were arranged on the following topics :

Changing trends in paint industry; Chemistry and technology of drying oils; Marine oils and their utilization in surface coatings; Natural and synthetic resins, Fundamentals of polymerization; Organic dyes and pigments; Inorganic pigments; Drier and other additives used in paints; Mixing, grinding and dispersion of pigments; Plasticizers—theory and practice; Plant practice in paint industry; Principles of paint formulations; Water-based coatings and electrodeposition of paints; Specialty coatings; Physico-chemical properties of coatings; Surface preparation and application of coatings; Metallic corrosion and its prevention; Modern techniques of analysis and testing of coating materials; Colours and measurement; Control and standardization of paints; Hazards and safety in paint industry; Cashewnut shell liquid, cardanol and their utilization; and National policy with regard to paint industry.

PATENTS FILED

246/72 : A process for the manufacture of slow-acting urea formaldehyde fertilizer, Mrs S. Laxmi, S. P. Srivastava & M. S. Iyengar—RRL, Jorhat.

770/72 : A modified distillation flask, F. Kiss—NPL, New Delhi.

771/72 : Precision linear feed movement device, D. K. Pramanik & G. Doraiswamy—CMERI, Durgapur.

772/72 : An improvement in or related to the manufacture of xanthotoxin from *Ammi majus* seeds, C. K. Atal, B. R. Sharma & K. L. Bedi—RRL, Jammu.

PATENTS SEALED

125605: A method of making anode block for magnetrons and apparatus therefor, J. Singh & J. L. Bahri—CEERI, Pilani.

127007: Improvements in or relating to the production of greaseproof paper and glassine paper, P. P. Baruah, B. P. Chaliha, S. B. Lodh & M. S. Iyengar—RRL, Jorhat.

127059: Improvements in or relating to the electrolytic reduction of nitroguanidine to aminoguanidine, H. V. K. Udupa, G. S. Subramanian, K. S. Udupa & T. D. Balakrishnan—CECRI, Karaikudi.

129746: An improved process for the manufacture of pine oil from turpentine oils of low pinene contents, K. Ganapathi, P. R. Rao, M. C. Nigam, C. D. Padha & S. N. Saproo—RRL, Jammu.

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Physical Research Committee : Progress of Research 1971

One hundred and thirty-three research schemes were under investigation as at the end of the year under the purview of the Physical Research Committee. During the year, two new schemes were sanctioned and 24 schemes were terminated.

A survey of 50 schemes selected at random from those which were active throughout the year has shown that about 30% of the schemes were in the area of solid state physics and crystallography, 15% related to spectroscopy, 10% to theoretical physics and 35% were concerned with miscellaneous subjects.

A meeting of the Physical Research Committee was held on 3 April 1971.

A brief report on some selected projects highlighting the important findings is given below :

The problem of stability of superposed viscous liquids subject simultaneously to electric and magnetic fields was investigated using the normal mode analysis. A configuration of an electrically conducting liquid topped by a dielectric liquid is envisaged in a downward gravity field. The electric field is assumed along the gravity field while the magnetic field is taken to be either along or normal to the electric field. Criteria of instability were derived in both cases. A vertical electric field was found to have a destabilizing influence and to render an otherwise stable configuration (bottom heavy arrangement) unstable for small wavelengths, while the magnetic field had a stabilizing effect.

The hydromagnetic stability of a composite system composed of infinitely conducting gravitating fluids was investigated by the normal mode analysis. The effects of hydromagnetic and gravitational coupling between the component fluids were studied in an initially static and a contrastreaming configuration. It has been found that an N-component static nongravitating system allows, in general, $(N+1)$ magnetosound modes in addition to a pure Alfven mode. The gravitational coupling in a static composite medium results in an instability leading to an incipient fragmentation whose size depends on the densities and the sound speeds of the individual components in the composite medium. The conditions for contrastreaming instability in gravitating plasmas have been derived in view of their likely importance in galactic dynamics and star formation from primordial matter. Finally, the analysis was extended to include dilute plasmas with anisotropic pressure, obeying the 'double-adiabatic' CGL equations—(Department of Physics and Astrophysics, University of Delhi, Delhi).

A comprehensive study of ages and of uranium concentration of 46 muscovite samples obtained from mica mines of Bihar, Rajasthan and Andhra Pradesh and from areas around Delhi and Haryana has been made. The effect of geological annealing in the samples has been assessed and suitable correction applied wherever necessary—(Physics Department, Kurukshetra University, Kurukshetra).

The liquid state properties of compounds containing $-C{=}N-$, and $-C{=}C$ and having small a/c ratios have been related to intermolecular dipole interactions. Some differences between the glassy state and the crystalline state have been analyzed in these terms. These properties have been suggested as precursors of the properties in the liquid crystalline state for molecules which have larger a/c ratios—(Department of Chemistry, Indian Institute of Technology, Delhi).

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Rb-Sr geochronology of Precambrian formations : Rb-Sr isochron age measurements have been carried out on about 50 rock and mineral specimens from different Precambrian formations of Mysore State. This has led to the delineation of a 2520 ± 100 M.Y. event in the Peninsular gneisses and a 2000±80 M.Y. event in the Closepet granites. Mica and feldspar ages indicate metamorphic episodes at 2300, 1350 and 800 M.Y.

These are the first Rb-Sr isochron age measurements carried out in India, using laboratory made mass-spectrometric apparatus. These and further unpublished measurements have revealed rock types in which ^{87}Sr rehomogenization has not taken place, as also older events at 2950 M.Y. in gneisses and 3250 M.Y. in conglomerates, thus establishing the ages of the older Dharwar basement —(Department of Physics, Indian Institute of Science, Bangalore).

An important result that the effect of suction is to stabilize the boundary layer near the disc rotating in a second-order fluid has been obtained under a research scheme at the Department of Mathematics, University of Roorkee, Roorkee.

The density matrix approach due to March and collaborators was used to obtain the electronic density of states of liquid aluminium. Using a model potential the density of states of aluminium for completely random and correlated systems was calculated and compared with experimental results. The result points to the nearly free electron-like behaviour of liquid aluminium—(Department of Physics, University of Roorkee, Roorkee).

The absorption of ultrasonics in liquids in the low frequency region was determined for the first time in India. The temperature coefficient of absorption of ultrasonics in the same low frequency region was successfully determined under a research scheme at the Physics Department, Nizam College, Hyderabad.

A transistorized reflectometer and a thermal probe for studying temperature-dependent effects (from very low temperatures up to the room temperature) of thin films have been designed and fabricated at the Physics Department, University of Roorkee, Roorkee.

The techniques of mechanical and chemical polishing of silicon wafers and of growing an oxide layer of desired thickness and diffusion have been developed. A KPR spinner has been fabricated and its speed optimized for good adhesion to oxide layer. Selective masking, using KPR, has been done. Oxide layers were etched to desired thicknesses by controlling the composition of the etchant and the time and temperature of etching. Photographic masks have been prepared for selective masking of desired areas to enable fabrication of photo-diodes of reproducible characteristics.

In a theoretical study, a piecewise exponential approximation has been developed for characterizing narrow diffused junction devices in order to consider the actual physical configuration of the diffused layer. Some results of technological importance have been obtained — (Department of Physics, IIT, Delhi).

Dielectric constant and dielectric loss measurements in five alkanethiols, viz. *n*-pentanethiol, *n*-hexanethiol, *n*-heptanethiol, *n*-octanethiol and *tert*-nonanethiol, in benzene at 3.5, 9.8 and 26.2 GHz have been made using Smyth's method. Static dielectric constant at 100 kHz, refractive index and density were also measured at 25°C. The mechanism responsible for asymmetric distribution of relaxation time appears to be multiple relaxation processes in the molecule—(Physics Department, Allahabad University, Allahabad).

The effect of an external alternating voltage on the transient and steady state characteristics of a CdS acoustoelectric oscillator has been studied experimentally. The incubation time of free oscillations as well as the frequency of steady oscillations is significantly changed by the external signal—(University College of Technology, Institute of Radiophysics and Electronics, Calcutta).

The ($n \rightarrow \pi^*$) transition in the crystal of 2,2′-pyridyl has been studied at 20°K (liquid hydrogen temperature) with polarized light. The absorption spectrum shows a progression of 710 cm^{-1}, which has been ascribed to CNC angular distortion mode of the ring. The O—O band is located at 24230 cm^{-1} from the observed excitation spectrum. The S→T transition has been located with a thick crystal and the corresponding emission studied.

The spin-forbidden $^3T_1 \rightarrow {}^1A_1$ transition in $K_3Mn(CN)_6$ at about 5400 Å was located. The ground $^3T_1$ level is split by the combined action of spin orbit coupling and lower field, leaving a non-magnetic singlet state lowest as found from ESR studies. A number of peaks have been observed around 5400 Å, some of which have been ascribed to transitions from a level 84 cm^{-1} higher than the non-magnetic singlet state—(Department of Magnetism, Indian Association for the Cultivation of Science, Calcutta).

The general method of the multipole expansion of intermolecular interaction was employed to develop a model for calculating the potential barrier-hindering angular motion and the possible off-centre displacement of polar impurities in alkali halide matrices. The calculated values of the barrier and the off-centre displacement have been used successfully to explain the librational frequency and the tunnel-splittings for OH$^-$, OD$^-$ and CN$^-$ impurities trapped in alkali halide matrices.

Buckinghem's theory of the solvent frequency shift has been applied to explain the shift of the band-centre of OH$^-$ and OD$^-$ impurities trapped in alkali halide matrices. An isotropic distortion of lattice around the impurity has been considered in order to explain the experimentally observed shifts. The values so obtained of the lattice distortion have been found to be in good agreement with those obtained from the Brauer's and the Hardy's models —(Physics Department, Allahabad University, Allahabad).

Tantalum thin film resistors and capacitors have been fabricated at the Department of Electrical Engineering, IIT, Bombay.

An oxyacetylene-flame Weissenberg camera has been developed for X-ray structural investigations from 1000 to 3000°C. The camera has a special hinged split cassette which permits the flame to escape without affecting the X-ray film. The unique feature of the camera is that routine structural investigations can be done up to 3000°C without the use of special radiation shields or water cooling systems—(Department of Physics, IISc, Bangalore).

K-Absorption edge of rubidium in metal and in its compounds: Measurements on the K-absorption edge of rubidium in the metal state have not been made so far because the metal ignites spontaneously in air. Hence measurements can be made only in its compound. A reliable measurement of K-absorption edge of rubidium in rubidium sulphate was made by the Uppsala group in 1934. The purpose of the present study is to make measurements of rubidium K-absorption edge in metal. Measurements have also been made in various compounds to record the chemical shifts.

To measure the absorption edge in metal, advantage was taken of the low melting point of rubidium. The metal was obtained in a sealed tube. The enclosed metal was soft and silvery white, and it (mp 38·89°C) melted inside the glass tube when the tube was immersed in a water bath at about 70°C. By carefully tilting the tube and taking it out of the bath, a film was obtained in the narrow neck of the tube without breaking the vacuum. This film was placed between the X-ray tube window and the curved crystal spectrograph to record the absorption spectrum—(Physics Department, Allahabad University, Allahabad).

The L-absorption spectra of tantalum, tungsten and rhenium have been recorded photographically using a newly constructed 1-m curved crystal spectrograph of transmission type. A pronounced absorption maximum, usually called a white line, has been detected both at the L_{II} and L_{III} absorption discontinuities of these elements. An attempt has been made to explain the appearance of the white line in the light of theoretically determined density of states.

The extended fine structure of L-absorption edges of rhenium has been investigated using 40 cm and 100 cm curved-crystal spectrographs both of the transmission type. It was found that the fine structure extends up to several hundred electron volts on the high energy side of the principal absorption discontinuities. The present results agree with Hayasi's theory—(Indian Institute of Technology, Bombay).

Crystals of gadolinium monoxide were prepared. A study of the growth conditions and of the superlattice formation upon reduction has been made. These crystals are important since it is known that monoxides have semiconducting properties. Studies on the correlation between stacking fault energy and structure of a polytype have shed fresh light on the growth and stabilization of polytypes—(Physics Department, Banaras Hindu University, Varanasi).

Intrinsic defect formation energies in thallium halides have been computed using a generalized formulation, with a much refined treatment of relaxation of ions around the defect, and employing a satisfactory model of cohesion parameters to decide the nature of the intrinsic defects.

A generalized formulation is being used to calculate the configurational energies of isolated defects and defect pairs with improved treatment of relaxations of ions nearest to the defects. The energies of association of vacancy pairs and divalent cation impurity-vacancy pairs in a first few associated states have been calculated and compared with earlier theoretical estimates.

Association energies of cation-anion vacancy pairs and divalent cation impurity-vacancy pair up to a few associated pairs in cesium halides have been evaluated by means of ionic lattice calculations with a rigorous treatment of relaxations of ions in the vicinity of the defects. The inclusion of a first few associated states in the treatment of defect association energies has been found to be necessary for proper interpretation of ionic conductivity and diffusion data in alkali halides—(Chemistry Department, Indian Institute of Technology, Kanpur).

Perturbation studies of the α-γ angular correlation for the (5486 α) (59·6 γ) cascade have been carried out in a polycrystalline ^{241}Am sample using the time-differential technique. The exponential trend of the angular correlation coefficients A_2 (t) vs t shows a strong time-dependent behaviour of the interaction phenomena. The value of the relaxation constant λ_2 has been found to be $(1{\cdot}81 \pm 0{\cdot}17) \times 10^9$ s^{-1}. The time-integrated perturbation coefficient obtained is G_2 $(t = 2{\cdot}4ns) = 0{\cdot}19 \pm 0{\cdot}01$, The value of the spin-relaxation time τ_s for the electron shell calculated was found to be $(1{\cdot}56 \pm 0{\cdot}63) \times 10^{-11}$ s. It is concluded that the time-dependent character of the angular correlation is carried primarily by magnetic interaction between the unfilled 5-electron shell of ^{237}Np and the magnetic moment of the nucleus, and secondarily by electron excitation of the neptunium atom.

Using nuclear physics techniques, information on solid state properties of the sample, such as spin lattice relaxation time and internal crystalline fields, has been determined —(Department of Physics and Astrophysics, University of Delhi, Delhi).

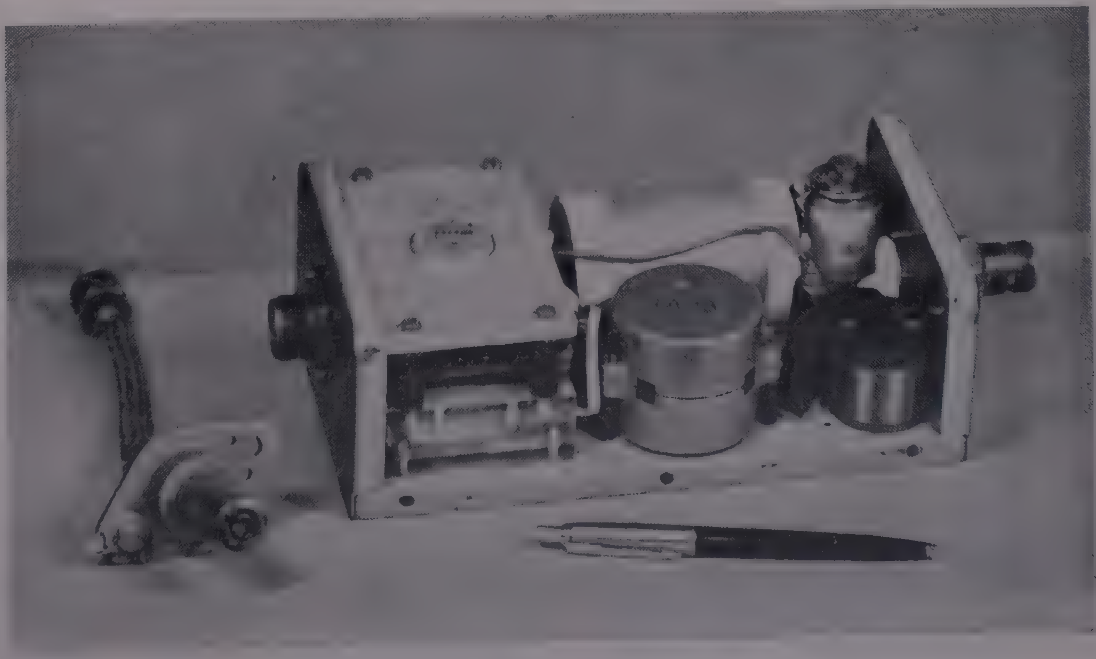
The study of ultrasonic attenuation in polycrystalline materials at elevated temperatures is gaining much importance. Recently, Darbari, Singh and Verma have devised a new method, viz. 'shouldered-specimen pulse echo technique'. In theoretical derivation of the expression for acoustic attenuation, α, they have, however, not considered the effects due to the spreading of the acoustic beam in the shouldered-specimen due to diffraction. The previous theory has been modified so as to take into account the effects of this beam spread due to diffraction. The modified theory finds excellent agreement with the experimental results, is applicable for any diameter of the transducer, and gives the correct picture of the propagation of the acoustic pulse in a shouldered-specimen—(Physics Department, Allahabad University, Allahabad).

Electronic Spark Igniter Exciter: NAL

The National Aeronautical Laboratory (NAL), Bangalore, has designed and developed an all solid state spark igniter exciter. This finds application in the starting of aircraft jet engines and is also useful in propulsion research.

The unit comprises a single transistor oscillator, a high voltage transformer, an energy storage type high voltage capacitor and a spark gap. The capacitor gets charged to a little over 2 kV when the spark gap triggers and discharges the energy into the semiconductor plug. The period between sparks is about 1 s and it is possible to adjust this period over a limited range. The unit accepts unregulated 28 V dc and delivers a high energy, high voltage spark (4 joules/2 kV) to a semiconductor igniter plug.

The main advantage of this unit over conventional electromechanical



Solid state high voltage igniter exciter designed and developed by NAL, Bangalore systems is its long, trouble-free life. It is small and compact in size and its maintenance is no problem. Comparable in cost to a similar imported unit, its performance in the laboratory has been found to be satisfactory.

Studies on Natural and Hydrogenated Fats

The fatty acid compositions of lipids isolated from different parts of *Ceiba pentandra*, *Sterculia foetida* and *Hydnocarpus wightiana* have been studied by Shri T. N. Balagopala Kaimal of the Regional Research Laboratory, Hyderabad, under the guidance of Dr G. Lakshminarayana of the laboratory.

Lipids were isolated from different parts of *C. pentandra*, *S. foetida* and *H. wightiana*. Positive Halphen response indicated the presence of cyclopropene fatty acids (CFA) in the lipids of seeds and roots of *C. pentandra* and *S. foetida*. NMR and IR spectra showed the presence of CFA and their dihydro derivatives in the root lipids of both trees. Cyclopropene fatty acids were present in the triglyceride, the fatty acid and diglyceride fractions of the root lipids of *C. pentandra*. The cyclopentene fatty acids which characterize the seed lipids of *H. wightiana* were absent in the lipids of leaves, trunk-wood and roots. The fatty acid compositions of the lipids in which CFA were present were determined by GLC after treatment of methyl esters with $AgNO_3$. The major fatty acids in the root lipids of *C. pentandra* were CFA, dihydrosterculic and linoleic acids. Malvalic was the main acid in the root lipids of *S. foetida* and linoleic in the lipids of buds, flowers and trunk-wood of *C. pentandra*, trunk-wood and stems of *S. foetida* and trunk-wood and roots of *H. wightiana*. Linolenic was the principal acid in the leaf lipids of *C. pentandra* and *S. foetida* and stearic acid in *H. wightiana*.

The changes in lipids of maturing *C. pentandra* seeds have also been investigated. Lipids were extracted with chloroform-methanol from *C. pentandra* seeds at different stages of maturity, separated by TLC and tested for the Halphen response. Cyclopropene fatty acids were absent in mono- and diglycerides and phospholipids. Free fatty acids, diglycerides and phospholipids were maximum on the 23rd, 65th and 65th day respectively and minimum on the 96th day (mature) after flowering. The fatty acid compositions were determined by GLC. Dihydromalvalic acid reached a maximum value on the 81st day, while malvalic acid remained almost constant from the 38th day and sterculic acid steadily increased. Dihydrosterculic acid was noticed only in the free fatty acids and phospholipids. The positional distribution in the triglycerides was determined by lipolysis. Since CFA inhibited lipolysis partially the triglycerides were dissolved in chloroform and treated with methanolic silver nitrate prior to lipolysis. CFA were found in the 2-position, though to a lesser extent than in the primary positions, indicating rearrangement of glycerides during maturation.

The limitations of periodate-permanganate oxidation in the determination of glyceride composition have been indicated. Oleic acid, methyl oleate, mono- and diunsaturated triglyceride concentrates, triolein, *Garcinia indica* fat and safflower oil were oxidized with periodate-permanganate reagent in aqueous 60% *tert*-butanol at 80°C (reflux temperature), 65°C and 28-30°C under different conditions. Significant proportions of unoxidized and partially oxidized compounds, mainly ketohydroxy compounds, were found in oxidation products. Hydrolysis of azelaoglycerides, particularly triazelain, also occurred. The di- and trisaturated glyceride contents are therefore likely to be higher than the actual for all fats when determined by Youngs and Subbaram's method and for fats containing high proportions of triunsaturated glycerides by Youngs' method.

Changes in glyceride structure during hydrogenation : Cottonseed oil was hydrogenated under relatively selective and non-selective conditions. Distribution of fatty acids in the triglycerides was studied by pancreatic lipase hydrolysis of samples isolated at different time intervals. Based on the percentage proportions of different fatty acids in 2-position of the triglyceride at different stages of hydrogenation, the following conclusions were made:

(1) Acyl migration occurs during hydrogenation of glycerides.

(2) Linoleic acids in the 1- and 3-positions of the triglycerides are hydrogenated faster than those present in the 2-position.

(3) Two linoleo groups at the 1- and/or 3-positions could be hydrogenated simultaneously.

(4) During the initial stages of hydrogenation, *trans*-acids are predominantly present in the 2-position. These observations have been explained on the basis of the tuning-fork structure of triglycerides.

The researcher Shri Kaimal was awarded Ph. D. degree by the University of Kerala for his thesis relating to the studies.

Lipid Peroxidation in Animal Tissues

Although the formation of lipid peroxides *in vivo* in such diseases as atherosclerosis is known, their precise role, if any, in functioning as immediate precipitating causes of tissue injury has not been elucidated under well defined conditions. Earlier work carried out at the Central Drug Research Institute, Lucknow, had indicated that the substrates which undergo oxidation are localized in the mitochondria and other particulate fractions of the cell. These substrates are presumed to be lipids with high unsaturation but there is no experimental evidence to prove this assumption one way or the other. Similarly, the catalysts that mediate peroxidation (pro-oxidant factors) are located in the cytosol fraction obtained by high speed centrifugation (1 06 000 g) of tissue homogenates but their nature has not been elucidated.

Investigations were, therefore, carried out with a view to characterize pro-oxidant factor present in rat tissues and an antioxidant factor present in guinea pig livers. Using isolated mitochondria, the effects of concentration of mitochondria, pro-oxidant factor(s), time of incubation, etc. were studied on lipid peroxidation in mitochondria isolated from different tissues of albino rats, sheep and guinea pigs. Versene was found to exert a very powerful antioxidant action on such *in vitro* lipid peroxidation.

Day-to-day variations were noticed in the ability of tissues to produce lipid peroxides. The catalytic activity of the cytosol fraction was heat-stable, diffusable through a semipermeable membrane, and had an absorption maxima between 265 and 275 nm. This absorbance had no correlation with the catalytic activity after gel (Sephadex G-10) filtration. The factor could be concentrated by preparative TLC or Sephadex filtration, but the resulting fractions were very unstable. This fraction did not give tests for ascorbic acid, iron, cysteine or glutathione.

A search for the hitherto undetected antioxidants in normal healthy guinea pig liver was carried out. An antioxidant factor isolated from guinea pig liver was readily reduced by potassium borohydride and did not give tests for tocopherol or quinones.

The effect of a number of commonly used anti-inflammatory drugs was studied in relation to lipid peroxidation. Acetyl salicylic acid was found to exert a powerful stimulatory action in brain tissues or rat while others inhibited the lipid peroxidation. Phenylbutazone and cortisone stimulated lipid peroxidation in liver tissue homogenates of rats as well as in mitochondria. Antioxidant activity could not be correlated with anti-inflammatory activity by this test [*Biochem. Pharmacol.*, **21** (1972), 1210].

The investigations were carried out by Shri Satish Chandra Sharma of the Biochemistry Division of CDRI under the supervision of Dr C. R. Krishna Murti and formed the subject matter of a thesis for which Shri Sharma was awarded the Ph.D. degree (1972) by the University of Udaipur.

PROGRESS REPORTS

ATIRA Annual Report: 1971-72

The Ahmedabad Textile Industry's Research Association (ATIRA), Ahmedabad, has brought out its annual report for 1971-72. The 63-page report (demy 4to) records the progress of R & D work under the following disciplines: Spinning technology; Weaving technology; Chemical technology; Basic studies; Engineering; and Instrumentation. Besides, the report contains a 10-page report from the director highlighting the association's activities in various areas during the year under review.

ATIRA's know-how on the permanent press process for cotton-polyester blend fabrics is being made available to UAR. A programme for training UAR technicians will be arranged. ATIRA will commission the process in two textile mills in UAR and demonstrate satisfactory working against specifications.

Conditions for chemical modification of tamarind seed kernel powder (TKP) to obtain products with lower paste viscosities have been standardized. The modified TKP has been evaluated in several mills as a sizing material in place of starches, and found satisfactory. No difficulties were encountered in desizing and in subsequent chemical processing such as bleaching and dyeing. With the use of this product, the sizing costs are expected to reduce by 50%.

A soil release agent, particularly useful for cotton-polyester blend fabrics and for permanent press finished fabrics, has been developed. The product is comparable to the best imported one. An indigenous substitute for sodium alginate, a thickener, has been developed under a project sponsored by a member mill.

The efficiency of carbamates, synthesized earlier in the laboratory, as softener in resin finishing has been evaluated. Based on evaluation and taking into account cost and indigenous availability, one of the carbamates has been selected for large scale manufacture. Conditions of manufacture have been standardized on a pilot plant scale. Formulation of an adhesive for nylon-stainless steel has been developed from indigenously available materials for use in screen printing.

Basic research, sponsored by national and international research agencies, was pursued in the three major fields: (1) structure and visco-elastic properties of cotton and its physico-chemical modifications; (2) chemical modifications of cotton and other polysaccharides to impart durable functional properties; and (3) mechanism of reactions at the fibre-solution interface. A project on the development of stochastic model for determining the efficiency of drafting, independent of the size of fibrous strands, to obtain basic information needed to improve the processing of cotton into useful textile materials was completed and a report was submitted to the PL-480 authorities, the sponsor of the project.

Seven projects were undertaken under the sponsorship of ATIRA members. These projects have a highly specific and clearly defined objective, which in majority of cases is development of a product of given specifications. The project on new techniques of spinning, which is of a broad and long-term national interest, was continued under CSIR support. Efforts at ATIRA are now being concentrated on the low twist spinning method.

Significant progress has been made with regard to the design and development of various process control equipment. Following evaluation both in the pilot mill and in a few member mills, the mechanical slub catcher was licensed to two manufactures in Ahmedabad. The design of electronic slub catcher was finalized, and 30 units were fabricated for evaluation under industrial conditions. A water flow rate indicator has been designed for controlling water consumption in mills. The design of the reed evaluator was finalized, and four units were supplied to member mills. A wet bulb thermometer has been designed for maintaining optimum conditions in stenters.

Under the consultancy and technical service of ATIRA, 42 operational surveys and 83 major consultation problems were undertaken and technical services rendered to member mills.

Five patents filed during the year relate to: (i) solution polymerization of vinyl monomers; (ii) wrap tension regulator; (iii) optical electronic slub catcher device: (iv) humidity control instruments; and (v) reed evaluator. Twenty-one research papers were published, and 6 research reports and 7 survey reports were brought out.

SASMIRA Annual Report : 1971-72

Weaving of high density polyethylene split film yarn, development of fabrics from acrylic fibre and its blends, and development of fibreglass fabric are the highlights of the work of the Silk & Art Silk Mills' Research Association (SASMIRA), Bombay, during 1971-72, according to its annual report published recently. The report (demy 4to, 55 pages) shows the associations' concerted efforts towards the solution of applied research problems and on market research activities.

Five projects of immediate benefit to the industry were completed under the sponsorship of industries. An improved loom model has been worked out by modifying an ordinary indigenous automatic prin changing loom model for weaving high density polyethylene yarn. The modified loom was found to give satisfactory performance.

A project on fibreglass weaving with a view to developing three qualities of glass fibre fabrics by using indigenous machinery with suitable modifications for yarn preparation and fabric weaving was undertaken and a detailed plant proposal for manufacturing fibreglass fabric was worked out. The proposal envisages the production of around 10 000 m of fibreglass fabric per month on 14 looms working two shifts. The machinery required has been detailed and the total cost for setting up the plant has been worked out. Fibreglass fabrics are finding increasing use as insulating material in electrical and electronic industries. The fabrics also have an outlet as reinforcing material in rubber industry.

Development of different varieties of fabrics from indigenously produced acrylic fibre, right from the fibre stage to the finished products, was undertaken under a project in order to provide guidelines to the man-made fibre fabric industry for the proper use of acrylic fibres and their blends. About 40 fabric constructions were developed for dress materials, sarees and suitings with different yarn counts, twists, blends and weaves.

Other important projects completed by SASMIRA relate to: (i) spinning and weaving of keratin/viscose fibre blend, sponsored by the Defence Research Laboratory, Kanpur, and (ii) development of various parachute fabrics, sponsored by the Aerial Delivery Research and Development Organization, Agra.

In order to increase the production of textured yarn in the country by improving indigenous technology, SASMIRA has undertaken three short-term research projects on texturizing process, texturized yarn and fabrics woven from texturized yarn. The project on texturizing process is expected to throw light on critical processing conditions in yarn texturizing, which will benefit the crimpers and users of crimped yarn. Evaluation of the properties of texturized yarn and the basic yarn will help in the formulation of standards for crimped yarn characteristics.

Another important project undertaken is concerned with multifunctional finishes for synthetic fibres. The object of this project is to synthesize multifunctional compounds capable of conferring on nylon and polyester fibres certain desirable end-use properties to make them more acceptable for production of fabrics for specific end uses.

Eight techno-economic and market surveys were concluded during the year under review. These included: (i) market study on nylon filament, polyester fibre and filament in India; (ii) market study of polyester staple fibre; (iii) nylon staple fibre in India; and (iv) nylon tyre cord in India. The techno-economic part of surveys covers the impact of excise duty on clothing industry and economics of small units in the man-made fibre fabric industry.

The laboratories of SASMIRA investigated 85 technological problems referred to by member units and the industry. The problems were concerned with defects due to fabric construction, tendering, stains and spots, improper dyeing methods and faulty processes in printing and finishing. Special technical consultancy services rendered by SASMIRA included in-plant studies in industrial units. Testing of samples of textiles and allied products, and fabrication of testing instruments constituted an important part of SASMIRA's technical service to industry.

PROCESSES & PRODUCTS READY FOR COMMERCIAL UTILIZATION

Aluminium Sulphate from Clays

Aluminium sulphate is used in paper and textile industries, and also as a flocculating agent for the purification of water. The extent of purity of aluminium sulphate determines its use in a particular industry. The limits for total iron contents are particularly incorporated in the specifications for aluminium sulphate. Aluminium sulphate with low iron content is obtained by using suitable raw materials like aluminium hydroxide, washed kaolin or selected grades of white bauxite. Because of the high cost of these raw materials, the end product is also very costly. It is advantageous to use bauxite as raw material for the manufacture of aluminium sulphate, because, for the same amount of aluminium, approximately half the quantity of bauxite requires to be processed. However, where limited quantities of bauxite deposits are available, cheaper raw materials like clay have been tried for the recovery of aluminium sulphate.

Most of the bauxite deposits in the country are located either in the south or in the basaltic zone of Bihar, and for aluminium-based industries in Assam and other remote areas bauxite has to be transported over long distances involving transportation bottlenecks and high costs.

In order to obviate the difficulties of transportation of bauxite and to manufacture aluminium sulphate from cheaper raw materials, the Regional Research Laboratory, Jorhat, undertook investigations and has successfully developed a process for making pure aluminium sulphate from clays locally available in plenty.

Process : The process consists in grinding the raw clay (alumina 30-40%; iron oxide 1-2%), heating it to a suitable temperature, digesting the heated clay with sulphuric acid and filtering the material through a filter press. The filtrate is evaporated in steam-heated evaporators. Aluminium sulphate is crystallized from concentrated liquid and centrifuged to remove excess acid, which can be reused. The adhering acid and iron oxide are removed by washing, and iron is removed during crystallization. The product is dried and packed. Recoveries to the extent of 95% of alumina from clays have been achieved. The process has been worked out on 100 g per batch scale.

Aluminium sulphate obtained by RRL process contains a minimum of 15% alumina and less than 0·1% iron, and is suitable for use in paper and textile industries.

Clay and sulphuric acid are the raw materials required for the manufacture of aluminium sulphate. High aluminium clays containing about 30% of alumina are available to the extent of one million tonnes in Ledo and Marghertia coal bearing areas of Assam. Huge deposits of lithomargic clay containing 39-42% of alumina are also available in the Tura region of Garo Hills. These clays contain about 1·2% of iron oxide.

Pulverizer, heating furnace, reaction vessels, evaporators, boiler, filter press, distillation unit, centrifuge and drying ovens are the main items of plant and machinery. All these can be fabricated indigenously.

The total capital outlay for a plant capable of producing 20 tonnes/annum of aluminium sulphate with a minimum of 15% alumina has been estimated at Rs 54 000 (Rs 48 600 on plant and equipment, and Rs 5400 as working capital). The cost of production of aluminium sulphate (minimum 15% of alumina and less than 0·1% of iron) by RRL process comes to 72 paise per kg.

Further particulars may be obtained from : The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

Paper Gasket

Paper gasket is mostly used in electrical and automobile industries where the operation temperature goes up to 100°C. At present there are only three firms manufacturing paper gaskets in the country, but these are based on imported technical know-how and imported paper. The exact demand for paper gaskets is not known. However, with the expansion of electrical and automobile industries, the demand for paper gaskets is bound to increase considerably.

Process : The Regional Research Laboratory, Jorhat, has developed a process for making these gaskets from bamboo pulp, which is available indigenously. The process consists in producing the base paper and converting it into finished product by impregnation with certain chemicals. Small size paper gasket samples prepared in the laboratory have been tested by a firm producing such products and found satisfactory.

Base paper and some common chemicals are the major items of raw materials required for the manufacture of paper gaskets. All these are available indigenously.

The major equipment required are vessels for solution preparation and storage, impregnation unit with drying arrangements, and trimmer.

The capital outlay for a plant capable of producing 0.5 tonne of paper gasket per day has been estimated at Rs 9·5 lakh (Rs 7·5 lakh on plant and machinery, and Rs 2 lakh as working capital). The cost of production comes to Rs 6550/tonne.

Further particulars may be obtained from : The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

CSIR SUPPORT TO RESEARCH

New Schemes

Control of Pollutants from Automobile Exhaust

In a new CSIR research scheme granted jointly to Dr K. S. Shah (principal investigator) and Shri K. Vikram Rastogi (co-principal investigator) of the Mechanical Engineering Department, M.R. Engineering College, Jaipur, it is proposed to investigate the effect of variation of engine parameters on the concentration of NO, NO$_2$, CO, hydrocarbons, etc. It is also proposed to design and fabricate instruments to limit and control the pollutants. The results of the investigations, it is expected, would facilitate in the framing of laws and regulations for controlling air pollution arising from automobiles.

Kinetics of Addition of Halogens to Unsaturated Compounds

The addition of halogens to carbon-carbon double bonds is of fundamental importance from several points of view. Most of the kinetic investigations on this reaction, carried out so far, in solution, have been confined to the addition of bromine to olefinic compounds. Very little work has been done on the addition of chlorine to such compounds. The object of a new CSIR research scheme granted to Dr R. Ganesan (principal investigator) of the Department of Physical Chemistry, University of Madras, Madras, is to investigate the kinetics of chlorine addition to unsaturated compounds in solution. Certain important kinetic and thermodynamic parameters, such as the total order of the reaction, the order with respect to the substrate and with respect to chlorine, the Arrhenius parameters A and E and the entropies of activation $\triangle S$, for various types of unsaturated compounds will be evaluated. These data are expected to lead to a clear picture of the reaction mechanism.

Inductive Voltage Dividers and Current Comparators

Inductive voltage dividers and current comparators are two variations of the general type of ac bridge networks known as bridges with inductively coupled ratio-arms. There have been considerable developments on these two devices for precision measurement and comparison of resistances and impedances to accuracies equal to or better than 1 in 10^6. Extensive research work is being carried out on the design and development of inductive voltage dividers for precision electrical measurements and standardization purposes in the National Bureau of Standards, USA, and at the National Physical Laboratory, UK. The National Research Council, Canada, is also engaged in the development of current comparators for similar applications. In India, not much work has been done on these devices. Under a new CSIR research scheme granted jointly to Dr D. P. Chakrabarty (principal investigator) and Shri S. K. Gupta (co-principal investigator) of the Electrical Engineering Department, Madhav Engineering College, Gwalior, the investigators intend undertaking the design and construction of 7-decade inductive voltage dividers on the Kelvin-Varley principle so that very smooth and gradual voltage division down to $1/10^7$ of applied voltage may be made possible.

The accuracy of voltage division in any individual decade is expected to be better than 1 part in 10^7. This will make it possible to measure or compare impedances with accuracies of the order of 1 part in 10^5 or better.

Though essentially measurements at ac can be done with these inductive voltage dividers, it is possible to extrapolate the dc value of resistors by measuring their resistance at several frequencies in the audio-frequency range. It has been shown by NPL (UK) that the dc resistance measured by such a technique has better accuracy/stability than by a dc potentiometer.

It is also proposed to design and construct a compensated current comparator with a current division accuracy of the order of 1 part in 10^7. These current comparators will not only be useful for precision measurements of resistances/impedances, but also will be particularly useful as standard equipment for testing current transformers.

PATENTS ACCEPTED

Indian Pat. 128412

Improvements in or relating to the electrolytic reduction of nitrobenzene to aniline

H.V.K Udupa, G.S. Subramanian & P.N. Anantharaman
CECRI, Karaikudi

This invention relates to a process for the manufacture of aniline from nitrobenzene by electrolytic means. Nitrobenzene is suspended in a catholyte of sulphuric acid (25% v/v) containing a hydrogen carrier, viz. titanous ion. The catholyte is separated from the anolyte by a ceramic diaphragm. The anolyte consists of sulphuric acid of same concentration and a lead strip as anode. A cylindrical copper electrode, which is kept under rotation, is used as cathode. The cell is covered, and suction with reflux condenser keeps the nitrobenzene within the cell. The temperature of the cell is maintained between 20 and 30° C. A current density (cathode) of up to 20 amp/dm^2 is applied. After complete reduction the solution is neutralized and the free base aniline is recovered by steam-distillation followed by the salting out of the distillate and solvent extraction with benzene. Yields of more than 90% are claimed. The novelty of this electrolytic reduction process lies in the use of titanous sulphate and rotating cathode.

Indian Pat. 129470

Process for production of frozen mango pulp from Dashehri and Chausa varieties

L.B. Singh & O.S. Sharma
NBG, Lucknow

Dashehri and Chausa are the most popular varieties of mango (*Mangifera indica* Linn.) grown in northern India. Mango fruit is highly perishable and cannot be stored for long in cold storages. Canning is also not very successful in the case of mango, because the original quality and flavour of the fruit are lost. Hence the availability of mango fruits is limited to a small period of the year. The invention under patent enables the preservation of the pulp of Dashehri and Chausa mangoes for more than a year, thus making them available throughout the year.

The process consists in pulping the healthy and fully ripe mango of the two varieties to remove the skin and stone from the pulp, packing the pulp in polythene bags, freezing the pulp in the bags at a very low temperature and storing it at −29° to −26°C. The frozen pulp retains its flavour, colour and nutritive value for a long time. Experiments have shown that the frozen pulp does not deteriorate on storing for two years.

The frozen pulp can be used as such or in the preparation of ice-cream, soft drinks, and confectionary products.

PATENTS FILED

773/72 : 1-Alkyl or aryl-4 (β-2-quinolyl- or 1,2,3,4-tetrahydroquinolyl)-ethylpiperazines, V. A. Rao, P. C. Jain, J. N. Sharma, H. C. Srimal, B. N. Dhawan & N. Anand—CDRI, Lucknow.

825/72 : A metering pump having spring plate and bellow tube with roller squeeze, S.K. Banerjee—CMERI, Durgapur.

826/72 : A fixture for winding coils on multiple legged formers for electronic equipment, J. Singh & F. Singh—CEERI, Pilani.

876/72 : A coating composition for the production of correction paper, C. N. Saikia, B. P. Chaliha & M.S. Iyengar—RRL, Jorhat.

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&
WASTE WATER ENGINEERING
Edited by
K. N. P. RAO & A. K. LAHIRI

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TANNING MATERIALS AND AUXILIARIES: CLRI

Tannin Extract from Tamarind Seed Husk and its Blends with Myrobalan and Babul

The Central Leather Research Institute (CLRI), Madras, has standardized a commercial process for the manufacture of a vegetable tanning extract from tamarind seed husk and its blends with myrobalan and babul. The process consists in the water extraction of water-solubles from tamarind seed husk alone or in blend with myrobalan, babul, etc. The correct proportion of tanning materials has been worked out. The leached solution having generally 10% solid content after being bleached is allowed to settle, and is evaporated to 40% solid concentration in an appropriate evaporator. The exact quantity of the bleaching agent required when the above mentioned items are used separately or in mixture has been worked out. The concentrated liquid extract can be marketed as such if so desired. The liquid extract can be converted to solid extracts using vacuum pan or spray dryers. A number of liquid, solid and spray-dried extracts have been made in larger batches at the institute and tested extensively in the institute's tannery and also in some commercial units manufacturing heavy leathers like sole leathers and E. I. kips, and the results were satisfactory. The conditions of manufacture of the extract have been standardized in repeated manufacturing trials with reproducible results. In tanning trials also, the leathers tanned were comparable to the leathers tanned with other tanning extracts presently being used.

New Basifying Agent for Chrome Tannage

This process relates to the development of a compounded mixture of masking salts and basifying agents, both soluble and insoluble, in suitable proportions. This new product can be used along with chrome tanning liquid during chrome tanning for basifying and is suitable for different tannages where chrome tanning is involved, as in full chrome, semi-chrome, etc.

By using the product in predetermined quantities based on the weight of hide and skins, basification takes place in a gradual manner, the final *p*H adjusting itself to a predetermined value. Tannage and distribution of chrome in the various layers of the leather are uniform and economy is effected in the use of chrome extract. The basifying agent reduces drumming time for the completion of tannage and produces full and smooth grained leathers.

After completing the standardization work on a laboratory scale, the laboratory has prepared the product on 10 kg scale and tested both in the laboratory and tannery with results comparable to those obtained in the usual procedures. The product has been found satisfactory in commercial tests.

Blend Extract from Myrobalan and Babul/Konnam

The process involves judicious blending of myrobalans, babul and konnam and water extraction, concentration and finishing. The correct proportion of tanning materials has been worked out. A number of solid and powder extracts have been made in larger batches at the institute and tested extensively in the institute's tannery and also in some commercial units. This tannin extract, named 'K' extract, can be used as a partial substitute for wattle extract in the manufacture of a variety of leathers.

Blend Tannin Extract from Wattle Bark and Cashew Testa/Babul Bark/Cutch Extract

The process involves judicious blending of wattle bark with babul/cashew testa/cutch extract and water extraction, concentration and finishing. Several solid and spray dried extracts were made in 0·5-1·0 tonne batches at the institute and tested. This tannin, designated 'L' extract, can be used as a partial or full substitute for imported wattle extract in the production of a variety of leathers.

Electrolysis of Some Sea-water Evaporites

Various processes are described in literature for the manufacture of magnesium hydroxide based on precipitation from bittern or magnesium chloride with alkali or lime. The hydroxide so prepared is the raw material for making many industrial magnesium compounds, viz. magnesium carbonates, silicates, etc., but its major application is in the manufacture of magnesium oxide which is widely used in refractories and as an insulating material, filler, building material and industrial chemical.

Generally, magnesium hydroxide is being produced using sea-water and liming agents. The process involves handling of huge quantities of sea-water, thickening, dewatering and filtering. On account of the slimy nature of the precipitate and low concentration of magnesium hydroxide in slurry, the thickening, filtration and washing operations are tedious and difficult. The development of an alternative process which is free from such difficulties has been engaging the attention of research workers. The main aim of these studies, reported in literature, was to obtain a rapidly filtering precipitate of magnesium hydroxide. It has been found that this could be achieved if the particle size of the product is increased by suitable devices in the conventional processes. A few research workers have worked on alternative processes of electrolysis. However, in the latter case, data on optimum conditions and current efficiency of the process are not adequate. The aim of the present studies, carried out by Shri D. A. Chauhan at the Central Salt & Marine Chemicals Research Institute, Bhavnagar, was to fill the lacunae in the information on the electrolytic process of preparation of pure magnesium hydroxide. The investigations were concerned with the preparation of magnesium hydroxychloride by electrolysis of concentrated bittern and magnesium chloride and of magnesium hydroxide by electrolysis of diluted bittern. Magnesium hydroxide has also been obtained by hydrolysis of magnesium hydroxychloride. The study was extended to the preparation of active magnesium oxide and to the understanding of some of the properties of the oxide relating to its activity.

Magnesium Hydroxychloride by Electrolysis of Concentrated Bittern

The factors influencing the electrochemical reaction have been studied in detail. These included: flow rates of magnesium chloride; current density by varying the area of immersion of electrodes as well as by varying the current; current at constant current density; ratio of the current densities; concentration of magnesium chloride; presence of other electrolytes; and recycling and dilution of catholyte. Formation of magnesium hydroxychlorides such as $3Mg(OH)_2 . MgCl_2 . 8H_2O$, $5Mg(OH)_2 . MgCl_2 . 8H_2O$, and $9Mg(OH)_2 . MgCl_2 . 5H_2O$ has been observed. The change in concentration of the electrolyte ($MgCl_2$) affects the composition; higher forms are formed with a decrease in the concentration of magnesium chloride. Presence of other electrolytes inhibits the reaction to some extent.

Magnesium oxide formed during the electrolysis goes into solution with concentrated magnesium chloride (electrolyte). The dissolution of magnesium oxide has been found to obey the first-order reaction kinetics. The activation energy has been calculated using the Arrhenius equation.

The electrolytic liquor, on standing for a long time, deposits magnesium hydroxychloride, showing an induction period which is less for higher concentrations of dissolved magnesium oxide. The rate constants for the deposition have been determined and are found to be independent of the concentration of dissolved magnesium oxide, indicating psuedo-first-order reaction kinetics. Stirring and increase of temperature accelerate the rate of deposition. Induction period decreases on increasing the rate of stirring and the temperature of reaction.

The mechanisms for the formation and dissolution of magnesium oxide and of the deposition of the dissolved magnesium oxide as magnesium hydroxychloride have been studied. X-ray diffraction, DTA and thermal decomposition of magnesium hydroxychloride have also been studied.

Hydrolysis of Magnesium Hydroxychloride

Pure magnesium hydroxide has been prepared by hydrolysis of magnesium hydroxychloride. The hydrolysis reaction was followed by measuring electrical conductivity. Conductivity increases continuously till the hydrolysis is complete. It is found that the velocity constants do not depend upon the initial concentration of the material used for hydrolysis. The rate constants increase with rise in temperature. The energy of activation has been calculated by applying the Arrhenius equation.

Pure Magnesium Hydroxide by Electrolysis of Diluted Bittern

Factors such as electrode material, flow rates, current, current density, concentration of magnesium chloride, presence of other electrolytes, shape and size of the electrolytic cell, which influence the preparation of pure magnesium hydroxide by electrolysis of dilute bittern, have been studied. On the basis of the results obtained, a process for the preparation of pure heavy magnesium hydroxide having sufficiently big particles and no settling and filtering difficulties has been worked out.

Also, conditions for obtaining a new compound, hemihydrate magnesium hydroxide [$2Mg(OH)_2 . H_2O$], have been worked out. X-ray diffraction and DTA data point to the formation of the compound.

The growth of magnesium hydroxide particles was followed by taking photomicrographs. X-ray diffraction patterns for magnesium oxide as well as for magnesium hydroxide and DTA for magnesium hydroxide have been examined.

Hydration of magnesium oxide has been studied as a measure of its activity. The following conclusions were arrived at: (1) The rate controlling step is the removal of product magnesium hydroxide from the surface of magnesium oxide. (2) The rate of hydration of aqueous magnesium oxide slurry under turbulent conditions is directly proportional to the surface area of the shell at the surface of particles. (3) The activation energy for this reaction is 13·87 kcal/g mol, indicating that the main rate controlling reaction is the chemical reaction. (4) Iodine number and velocity constant for hydration are related.

The effect of both slow and shock calcination, time and temperature of calcination, initial moisture content and aging on the properties of magnesium oxide have been studied. It is seen that maximum activity is attained in the case of the electrolytic magnesium hydroxide decomposed at 350°C. Particle size distribution shows that the magnesium hydroxide prepared by electrolysis has a much larger particle size than that prepared by the conventional method. This makes it an easily filterable and washable product. Magnesium hydroxide aggregates are transparent, and on calcination become opaque due to the collapsing of the aggregate. There is no appreciable change in the bulk density of the product obtained during the study of various factors for the activation; the bulk density is about 0·55 g/cm^3 in all the cases.

On the basis of the results obtained, a process for high purity magnesium hydroxide has been developed, and different grades of magnesia have been prepared from magnesium hydroxide and magnesium hydroxychloride obtained by the electrolytic process. Also, a process for the preparation of pure light magnesium hydroxide by hydrolysis of electrolytic magnesium hydroxychloride has been evolved. Processes for both heavy and light pure magnesium hydroxides have been worked out. The cost of production, calculated from the energy consumption and yield, works out to about Rs 1·20/kg. It is therefore expected to be the cheapest process.

Shri Chauhan, who carried out the investigations under the guidance of Dr D. S. Datar, ex-Director of the institute, was awarded Ph.D. degree by the Gujarat University.

PROGRESS REPORTS

NCL Annual Report : 1971-72

The annual report of the National Chemical Laboratory (NCL), Poona for 1971-72, published recently, shows the laboratory's concerted efforts to achieve its basic objective of economic progress through research and development in the fields of chemistry and chemical technology. Besides project-wise reports under 13 major scientific and technological areas, the annual report sets out the objectives of the laboratory and the areas of its R & D activities planned keeping in view their relevance to country's socio-economic needs and goals as outlined in Five-Year Plans, and the national tasks identified by the National Committee on Science and Technology. Against a total expenditure of Rs 94·35 lakh the income of the laboratory during the period amounted to Rs 15.45 lakh.

During the period under review, 12 sponsored projects were completed and 10 new schemes were undertaken. Product-oriented projects numbered 118 and their breakup into various areas of R & D were as follows: solid state materials—10; inorganic chemicals and products—15; naturally occurring organic compounds/products—24; industrial organic chemicals—31; resins and elastomers—16; chemical engineering and process development—17; and instrument development—5.

A process for the preparation of flexible magnets, used in refrigerator gaskets, toys and educational kits, has been standardized. The product compares well with the imported material. A new equipment suitable for commercial production of synthetic gem has been designed and is being fabricated.

Under a project taken up at the instance of the India Meteorological Department, radiosonde thermistors, presently imported, have been developed and found satisfactory by the Department. Piezoelectric behaviour has been observed for the first time in semiconducting glasses. The system studied was a V_2O_5–P_2O_5–Tl_2O_3 composition.

A project investigated under the sponsorship of Chemicals India Ltd, Udaipur, was concerned with the preparation of hydrated calcium silicate from wollastonite, a naturally occurring calcium metasilicate, on 400 g and 1 kg/batch scale. Conditions such as acid concentration, particle size of mineral, order of addition of the reactants and dilution were also worked out. At the instance of a paper pulp unit, the removal of silica from black liquor was investigated and the results were provided to the sponsor firm, who are taking up the commercial utilization of the technology developed.

Another project undertaken in the field of inorganic chemicals and products on sponsored basis relates to the chlorination of bauxite residue, available as byproduct from the ferric alum plant of the sponsor, at high temperatures to yield aluminium chloride and titanium chloride. Cadmium sulphoselenide pigments are used in plastic, ceramic and printing ink industries, and are presently imported at a cost of about Rs 39 lakh/annum. Three shades — yellow, orange and red— of these pigments have been prepared; their tinting strengths have been determined by ASTM method and found to be comparable to those of imported samples.

A process for making dibutyl tin maleate (solid), a PVC stabilizer, has been developed. A laboratory method for making the wood preservative, tributyl tin oxide (500 g/batch), from butyl chloride, magnesium and stannic chloride has been standardized.

A 5-year project on wood phenolics, sponsored by the U. S. Department of Agriculture, was concluded. From *Artocarpus*, *Morus*, *Garcinia* and other genera, 48 new compounds have been isolated, and the structures of 23 have been determined.

A new method for the preparation of an epoxide of Δ^3-carene (500 g/batch scale), which gives good yields, has been worked out. A systematic procedure for the isolation and purification of colchicine, used in pharmaceuticals and also in plant breeding, from *Iphigenia stellata* has been standardized on one kg per batch scale.

Under a sponsored project investigated on behalf of the Jammu & Kashmir Government, filterability of the pulps produced from Kashmir softwood was improved by suitable modifications in the processing of pulp. Samples produced under optimum conditions were tested at the Forest Products Research Laboratory, Stockholm, and counter-tested under similar testing conditions. The results of both the tests were in good agreement and the pulps produced compared well with the similar commercial pulps in filterability.

Organic intermediates for which processes have been either standardized or worked out include: (i) *p*-nitroacetophenone (0·5 kg/batch), the starting material for the manufacture of chloramphenicol; (ii) *p*-phenetidine, an intermediate for the manufacture of phenacetin; (iii) monochloroacetic acid and trichloroacetic acid, intermediates for the manufacture of weedicides and herbicides, by direct chlorination of acetic acid; (iv) I.P. grade benzoic acid from crude methyl benzoate; (v) 2,2,4-trimethyl - 6 - ethoxy - 1,2 - dihydro - quinoline, used as an antioxidant and flex-cracking inhibitor in rubber industry; (vi) thioglycolic acid, used in cosmetics, in hair fixation preparations and as an essential additive in the preparation of bisphenol-A; (vii) *m*-phenylenediamine, used as a coupling component in the synthesis of direct dyes; and (viii) bisphenol-A, an intermediate for making epoxy resins.

A four-step synthesis of vitamin B_6, starting from paraldehyde, on a laboratory scale has been completed. The cost of vitamin B_6 by this route has been estimated at about Rs 425/kg. The imports of vitamin B_6 during the year ending March 1971 were of the order of 2750 kg, valued at Rs 6.74 lakh. A commercially feasible process for the production of N,N-dimethylbiguanide hydrochloride and phenethylbiguanide hydrochloride, valuable antidiabetic drugs which are at present being imported under the trade names Metformin and Phenformin, has been developed.

Synthesis of compounds with potential biological activity was continued. Tetra- and pentacyclic phenothiaphosphine oxide derivatives have been synthesized. Dihydrothiazole-(3, 2-*a*)-quinoline and dihydrothiazole-(2, 3-*a*)-isoquinoline have also been synthesized starting from quinoline and isoquinoline N-oxides respectively.

The laboratory has been maintaining a national collection of 1400 non-pathogenic microorganisms required by research institutions and industries. Screening of new industrial microorganisms suitable for production of industrially important enzymes such as alkali stable protease, acid stable amylase, and cellulase and for 2-keto-L-gluconic acid, which is the key intermediate for the manufacture of vitamin C, is in progress.

Polystyrene foam finds extensive use in low temperature insulation and packaging. Samples of expandable polystyrene beads having good foaming chracteristics and bulk density have been prepared. The thermal insulation and compression strength of the sheets made from these beads were found comparable to those of similar products in market. Work on lining compositions based on synthetic rubber latex has been completed. These compositions have been tested by can manufacturers and found suitable for sealing metal cans for packing foodstuffs, mineral oil and greases.

Thermosetting resins which impart cold punching properties to the industrial laminates are not produced in the country and have special uses in electrical insulation industry and for electronic components used in TV. Under a project sponsored by Formica India Ltd, Poona, the preparation of two types of resins has been standardized on 3 kg/batch scale. The laminates made by using these resins were found comparable with the imported product. A large number of filter cartridges (3×10 in.) using different types of cellulose pulps and resin binders were prepared and evaluated for filtration of water, milk and certain solvent solutions.

Sulphonated polyolefin elastomers (SCPE) possess several outstanding properties such as resistance to weather, heat and chemicals, and find applications in chemical resistant linings and protective coatings to different substrates such as fabrics, cables, gaskets, wood and shoe-sole. A one-step modification of the process (Indian Pat. 130254), developed earlier by NCL, was evolved and a product comparable to Hypalon-20 in mechanical and chemical properties was obtained.

A new bond-energy scheme for predicting thermodynamic properties of hydrocarbon monomers and polymers has been developed. The monomer reactivities in copolymerization are important kinetic constants that control the copolymer composition. A new analytical solution for copolymer composition equation was evolved. The procedure has been extended to the integrated copolymer equation and a computer programme has been drafted to compute the reactivities of monomers with high accuracy.

Under a project sponsored by Sudarshan Chemical Industries, Poona, work was undertaken essentially to collect data for the design of a plant (capacity, 200 tonnes/annum) for producing ketene from acetone, and designs of a reactor for producing 10-15 kg/hr ketene along with the list of equipment and their sizes were submitted to the sponsor. A two-stage process for the manufacture of oxyurea, an anti-crease agent used in textile finishing, was developed. The process was subsequently developed on a pilot plant scale on sponsored basis on behalf of Calico Chemicals & Plastics Division, Bombay. A series of experiments were carried to produce terephthalic acid, an intermediate for polyester fibre, using Henkel process (disproportionation of benzoic acid). A reactor was designed and fabricated, and several runs on 1·5 kg per batch scale were carried out satisfactorily. A reactor of 10-15 litres capacity with improved design has been designed and fabricated with the assistance of MERADO, Poona.

A pilot plant to chlorinate 2-3 kg/hr of enriched ferro-silicon to yield silicon tetrachloride has been designed and fabricated. Starting from silicon tetrachloride, the preparation of ethyl silicate-40 (40% silica by weight) has been standardized on 1 kg/batch scale.

In the field of instrumentation technology, work on the fabrication of dc recording polarograph was completed and a prototype was fabricated.

The know-how relating to the following nine processes/products was released to industry: (1) benzoic acid from methyl benzoate (available with the Indian Petrochemicals Corporation Ltd); (2) substitute for Bostik sealants; (3) dimethylaniline; (4) hard ferrites; (5) monochloroacetic acid; (6) phthalates—dioctyl and dibutyl; (7) *p*-nitrophenol; (8) sachets—hot and cold; and (9) terpineol.

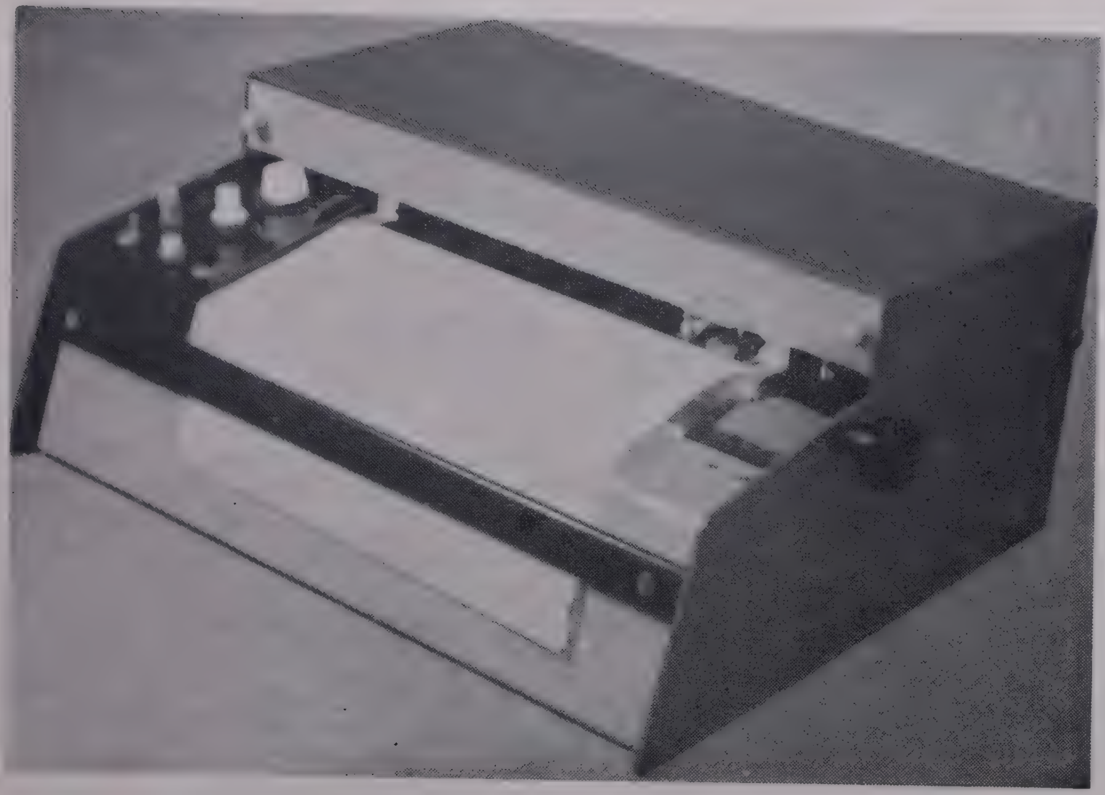
Sixteen patents were filed and 77 research papers were published during the year.

PROCESSES & PRODUCTS READY FOR COMMERCIAL UTILIZATION

Potentiometric Strip Chart Recorder

A self-balancing potentiometric recorder having a valve amplifier has been developed by the National Chemical Laboratory (NCL), Poona. This instrument can be used in conjunction with a gas chromatograph, polarograph, or infrared/ultraviolet spectrophotometer, and also for the measurement of temperature, pressure, displacement and flow in process industries.

No reliable data regarding the demand for these recorders are available. However, the Bhabha Committee Report and other surveys indicate that the requirements would be 4000 to 12 000 units per annum.



Potentiometric strip chart recorder: NCL, Poona

The characteristics of the unit developed at NCL are as given in Table 1.

Table 1—Characteristics of potentiometric strip chart recorder developed by NCL

ELECTRICAL	
Span (full scale voltage)	: 1 mV
Response time	: 1 s or better
Input resistance	: 150 Ω
Zero supression	: one full scale
Sensitivity	: 0.25%
Accuracy	: 0.5%
Power requirements	: 230 V ac, 50 c/s, 30 W
MECHANICAL	
Dimensions	
height	: 10.5 in.
breadth	: 13.00 in.
width	: 18.5 in.
Weight	: 18 kg
Chart width	: 10 in.
Chart speed	: normally 15 in./hr; can be changed with gears to lower and higher speeds. Also, any desired speed can be incorporated.

All the components with the exception of the electromechanical chopper are available indigenously.

The total capital outlay for a plant capable of producing 1200 pieces/annum has been estimated at Rs 12.80 lakh (Rs 4 lakh on building and equipment, and Rs 8.80 lakh as working capital). The ex-factory selling price of the recorder fabricated by NCL know-how has been estimated at about Rs 2350 per unit. The price of the imported recorder ranges from Rs 8600 to 12 000 per unit cif.

Tension Meter

Tension meters are widely used in cable making and textile industries to measure the tension of wires and yarns while they are being processed. Accurate control and measurement of tension becomes a matter of paramount importance in the quality control of products in these industries.

The Central Mechanical Engineering Research Institute (CMERI), Durgapur, has developed a tension meter which mainly consists of dial gauge, three small pulleys mounted on ball bearings with a suitable mechanism for sensing the tension of the wire which is allowed to run between three pulleys. It is a small, handy instrument which indicates the tension on a calibrated dial gauge directly. The meter can be fabricated for different ranges of tension with minor changes in some components. The meter developed by CMERI measures the tension of wires up to 3 kg. A prototype has been designed, fabricated and tested in the laboratory and found satisfactory.

Dial gauges and small sized ball bearings are the main auxiliaries. The raw materials required are mild steel rods and aluminium castings.

At present no firm is manufacturing tension meters in the country. The device developed by CMERI can be manufactured even by a small scale industry, as no special plant or machinery is required. The annual demand for this instrument, of different ranges, is estimated at 100 units. The cost of production has been estimated at about Rs 500 per unit.

Further particulars may be obtain from: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

Tension meter : CMERI, Durgapur

Phenacetin

Phenacetin is used as an analgesic and antipyretic. The present demand for this drug is mostly met by imports (210 tonnes/annum). The Indian Drugs Pharmaceuticals Ltd (IDPL), Hyderabad, and a few other firms are producing phenacetin. The target for this drug by the end of the Fourth Plan period has been put at 250 tonnes/annum.

The National Chemical Laboratory (NCL), Poona, has developed a process for the manufacture of phenacetin. The process consists in reacting phenetidine with acetic acid in liquid phase under atmospheric pressure. The water of reaction is removed by an entrainer and the unreacted *p*-phenetidine is completely reacted with acetic anhydride. From the product, excess acetic acid, unreacted *p*-phenetidine (if any), and entrainer are removed by distillation under vacuum, and phenacetin is recrystallized. The time cycle for the main reaction of the process is about 8 hr. The process has been studied on 60 kg/batch scale. The product has been tested and found to conform to the desired specifications.

The main raw materials required are *p*-phenetidine, acetic acid, toluene and acetic anhydride. Of these, *p*-phenetidine will have to be imported. Some quantity of this material is, however, being manufactured by IDPL for their own use.

Stainless steel jacketed reactor fitted with stirrer, reflux column condenser and separator, stainless steel crystallizer, stainless steel centrifuge, and storage and dissolving tanks are the major items of plant and equipment. The entire equipment can be manufactured indigenously.

The minimum capacity of an economic industrial unit for the production of phenacetin has been assumed as 100 tonnes/annum by NCL. The total capital outlay for a plant based on imported *p*-phenetidine has been estimated at Rs 13.17 lakh (Rs 5.60 lakh on building and plant, and Rs 7.57 lakh as working capital). The cost of production comes to Rs 16.30/kg as against Rs 22/kg for the imported material. If indigenous *p*-phenetidine is used, the capital outlay would be reduced by Rs 57 000. The cost of production with indigenous *p*-phenetidine is estimated at Rs 21.45/kg, assuming that the chemical will be available at Rs 20/kg.

Further particulars may be obtained from: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 24.

CSIR SUPPORT TO RESEARCH

Completed Schemes

Tunnel Diode Triggers

High switching speed and the negative resistance are the most attractive properties of the tunnel diode. Shri S. L. Sarnot, a CSIR research fellow, has carried out studies, under the guidance of Dr A. B. Bhattacharyya, at the Department of Physics, Indian Institute of Technology, Delhi, on this device mainly with a view to understanding it as a switching circuit element. An extensive analysis of the bistable and monostable triggers has been made and the switching times and wave forms when the tunnel diode switches from one stable state to another stable state have been calculated. The theoretical results were checked by the experiments performed in this laboratory and elsewhere. The analysis and study of the tunnel diode monostable and bistable triggers have led to a better design of tunnel diode binary counters. The studies constituted the subject of a thesis titled 'Theory, design, and some applications of tunnel diode triggers', which was in partial fulfilment of the Ph.D. degree of IIT awarded to Shri Sarnot in 1971.

Tunnel diode transistor hybrid circuits

Tunnel diode being a two-terminal device, it has a problem of isolation between the input and output systems. Moreover, the output voltage swing is also very small. These difficulties can be overcome by using a hybrid combination of transistor and tunnel diode. Various combinations have been studied both experimentally and theoretically and the results have considerable practical value. A binary counter was designed using one tunnel diode and one transistor, and was tested up to 3 Mc/s. The simplicity of the design and use of fewer components are the main features of this circuit.

MIM and MOS junction

The interface properties of the metal-insulator-metal (MIM) and metal-oxide-semiconductor (MOS) junctions have been studied. In the study of MIM junctions, emphasis was laid mainly on the tunnelling aspect, and the effect of the band structure on the voltage-current characteristics of the device was extensively studied. The band structure effect has been found to be very prominent and could account for two to three orders of magnitude deviation between the experimental and theoretical value.

Studies on Complex Forming Systems

The composition, stability and thermodynamic functions associated with complex formation as well as analytical applications of metal chelates have been investigated by Kum. Sunita Rani, a CSIR research fellow, in the Department of Chemistry, Birla Institute of Technology and Science, Pilani, under the supervision of Prof. Samir K. Banerji, of the Department, during the period Nov. 1969 to Nov. 1971.

Two classes of ligands were chosen, viz. quinalizarin (QZR) and quinalizarin-2-sulphonic acid (QSA) belonging to hydroxyanthraquinone group of dyes, and 1-(5-bromo-2-pyridyl)-azo-2-naphthol [5-Br-β-PAN] belonging to azo dyes. Spectrophotometric and potentiometric techniques were used in the study.

QZR chelates of thorium(IV), zirconium(IV), hafnium(IV), chromium(VI), molybdenum(VI), tungsten(VI), and uranium(VI) in 50% alcoholic medium were studied in the visible region of spectra. Although it is not possible for steric reasons to coordinate all donor groups in quinalizarin to a single metal ion, there are two alternative positions where chelation may occur in quinalizarin. Binding of metal to quinone oxygen and the adjacent hydroxyl group would result in the formation of a six-membered chelate ring, whereas bonding between the adjacent phenolic groups would produce a five-membered ring. Zirconium, hafnium, molybdenum and uranium form 1 : 1 complexes; thorium, chromium and tungsten form 1 : 2 complexes. The sequence of stability constant for trivalent metals was $\mathrm{Th} > \mathrm{Zr} > \mathrm{Hf}$. The values of stability constants of the chelates increased with increase in temperature [with the exception of uranium(VI) chelate]. This indicates exothermic reactions in all the cases except in the uranium(VI) chelate which undergoes endothermic reaction. The positive entropy change accounts for the stability of complexes. Studies on the effect of the ionic strength on the stability of complexes show that the curve in all the cases passes through a minima. QZR was used for the determination of molybdenum(VI) and uranium(VI) and it was found to be a very sensitive reagent but not selective. Stepwise stability constants at three different ionic strenths were found for QZR chelates of zirconium(IV), hafnium(IV) and uranium(VI).

Chelates of QSA with aluminium (III), gallium(III), indium(III) and thallium(III) were investigated. The chelation with this ligand may occur between any of the two alpha phenolic oxygens and adjacent quinonoid oxygen. All these chelates have 1 : 1 composition. The sequence of stability constants was as $\mathrm{Al} < \mathrm{Ga} < \mathrm{In}$. The chelates were found unstable at higher temperatures. Stepwise stability constants for aluminium(III), gallium(III) and indium(III) were investigated.

Studies on 5-Br-β-PAN chelates of gallium(III), indium(III) and uranium(VI) were carried out in 50% dioxane-water medium. This ligand acts as a tridentate ligand forming two stable five-membered rings by means of the *o*-hydroxyl group, the heterocyclic nitrogen and the azo group. All the three chelates had 1:2 composition. The sequence of the stability constant was as $\mathrm{Ga} < \mathrm{In} < \mathrm{U}$. As a reagent for the determination of gallium-(III) and indium(III), 5-Br-β-PAN in not very selective.

The investigations formed a thesis for the Ph.D. degree (1971) of the Birla Institute of Technology and Science.

Nature and Mechanism of Transpassive Potential Oscillations in Nickel-Sulphuric Acid System

The theories proposed to explain the transpassive potential oscillations when nickel is anodically polarized in sulphuric acid take into consideration one or the other parameter which are supposed to change periodically. In these theories no mechanism has been given. Indira and Doss postulated the stoichiometric region (SR) and *p-n* junction (PNJ) mechanisms for buildup and breakdown of potential.

This phenomenon has been studied extensively by Shri Dilip Deshmukh, a CSIR research fellow, who worked at the Department of Chemical Engineering, Indian Institute of Technology, Madras, under the direction of Prof. K. S. G. Doss, Scientist Emeritus of CSIR. The theories put forward by other workers have peen shown to be of little significance. The Indira and Doss postulates have been critically examined. On the basis of these postulates and experimental results an elaborate theory has been put forward. This modified theory takes into account the solid state conduction mechanism as also the mechanical factors responsible for the breakdown of the film.

With a view to gaining further knowledge on the nature of these oscillations, the effects of various parameters such as stirring, current density, sulphuric acid concentration, ac superposition, and ac frequency were studied. These effects have been interpreted in terms of the modified theory.

It the theories put forward by earlier workers the effect of solution side factors were emphasized. A simple but effective experiment of stirring the electrolyte during oscillations shows that the oscillations are in no way affected, thus proving that the factors on solution side are not as important as the solid state effects.

It was found that the oscillations could be obtained in a limited range of current density only. Above this density range oxygen evolution starts and below this the oscillations damp out. The optimum current density, lying somewhere between, gives the largest amplitude of oscillation with maximum frequency. These observations have been interpreted on the basis of the proposed theory.

At different concentrations of sulphuric acid the amplitude, time period and the shape of the curves were greatly affected. Thus, from $4M$ to $0.2\,M$ H_2SO_4 the oscillations become slower and slower. The amplitude increases as the concentration is varied from $4M$ to $1M$ and then decreases from $1M$ to $0.2M$. At $0.2M$ the oscillations were damped and at $4M$, they were irregular. The current densities also varied with concentration. For example, oscillations in $3M$ could be obtained only up to a maximum current density of 37 mA/cm^2, in $2M$ up to 20 mA/cm^2, in $1M$ up to 15 mA/cm^2, and so on.

Alternating current superimposed on dc during potential oscillations increased the frequency of oscillations and decreased the amplitude. In one experiment, with thermocouple grade nickel, a time period of 1.6 s at 19 mA/cm^2 dc was brought down to 0.55 s with 25.2 mA/cm^2 ac superposition.

The superimposed ac with different frequencies gave an interesting result: with 50 c/s and 100 c/s the time period was smallest.

At low temperatures the period and amplitude of oscillations were found to increase tremendously. Thus, with thermocouple grade nickel a time period of 143 s was observed. At low temperatures the current density required for oscillation was also much lower.

Addition of different anions, viz. Cl^-, Br^-, I^-, and SO_4^{2-}, was studied. All of them were found to slow down the oscillations, and increased amounts of the ions stopped the oscillations. The oscillations were greatly disturbed by stirring.

Potentiostatic polarization curves, plotted for room temperature and low temperature and with addition agents, were compared with galvanostatic curves. A working hypothesis has been proposed to explain the nature of curves on the basis of solid-state conduction mechanism.

Observations through a metallurgical microscope supported the view that very little oxygen is evolved at the anode during oscillations and cannot bring about large changes in potential as suggested by some workers.

A kinetic equation has been formulated for the rate of SR buildup on the basis of fundamental considerations. The validity of the equation has been experimentally verified in some of its aspects. It has been shown that this equation and the theory as such are applicable to other systems also which show such periodic behaviour.

PATENTS ACCEPTED

Indian Pat. 127373

Improvements in or relating to prestressed roofs on floors and hollow clay blocks therefor

Zacharia George & P.M.A. Rahman
SERC, Madras

Burnt hollow clay blocks of structural quality are suitable materials for use as roof and floor elements. These are, at times, used as filler blocks between steel, prestressed concrete, or reinforced concrete battens to form the roof or flooring system. In such systems, the structural properties of the burnt clay blocks are not fully utilized. Moreover, when filler blocks and battens are made of different materials, the texture of ceiling causes differences in absorption and thereby cracking of the plaster when the ceiling is plastered. Another drawback of the hitherto known clay blocks used for prestressed roofs or floors is that the sizes and unsupported lengths of wet clay after extrusion result in cracks and warping, and hence large wastage. Also, the burnt blocks break while they are being inserted around tensioned wires.

This invention relates to the efficient use of burnt hollow clay blocks of structural quality and reduction in the wastage of clay blocks due to cracking and breakage while fabricating battens/panels of prestressed clay blocks for roofs and floors. The technique developed for making prestressed roofs or floors consists in placing blocks around tensioned wires, followed by concreting around the wires in the gap created by the blocks to form pretensioned battens or panels. Blocks having inverted T cross-section are placed on the two sides of the tensioned wires instead of inserting a single block with double leaves or grooves from below as is done in the process in vogue. This new technique eliminates the chances of breakage resulting from inserting the blocks from below the tensioned wire.

The hollow clay block has preferably a depth of 10 cm or more with a minimum wall thickness of 1 cm and a hollow core of 8×2 cm or more. The blocks are extruded preferably in lengths of 30-50 cm and burnt to give a strength of not less than 225 kg/cm^2. The blocks have built-in deformation, like grooves, to provide the key for concrete and plaster.

Ths floor or roof is made up of a series of such battens and filler blocks or panels. The battens are kept at desired spacing so as to fit in the filler block between the battens. Panels are made by prestressing the blocks along with filler blocks by placing the filler blocks in the inverted position, thus giving space for placing high tensile wires and concrete to give full structural connection between the blocks and filler blocks.

The main advantages of the processes are that: (i) it is easy to fabricate, place and join the blocks in pretensioning bed; (ii) losses due to breakage are reduced since the elements are of small size; (iii) use of moulds for pretensioning is eliminated; and (iv) savings to the extent of 20% in steel and cement can be effected in comparison with the quantity of these materials required in the conventional solid slabs of reinforced cement concrete.

Corrosion Control in Water and Waste Water Engineering

The huge losses arising from corrosion and the closure of plants owing to damage caused by corrosion have been attracting the attention of scientists and technologists. Considerable progress has been made in the theoretical and practical aspects of corrosion control technology. The Corrosion Advisory Bureau (of the Metals Research Committee of CSIR) has endeavoured to bring about 'corrosion awareness' among plant engineers, scientists, technicians, and others concerned with these problems.

Towards this end the Bureau organized a short course on Corrosion Control in Water and Waste Water Engineering in collaboration with the Central Public Health Engineering Research Institute (CPHERI) in Nagpur from 24 to 27 Feb. 1971 in which 76 participants took part. The publication under review covers the proceedings of the course [*CSIR News*, **22** (22), 176].

The four-day course ran into the following six sessions : (1) Water chemistry and corrosion, (2) Industrial cooling water, (3) Corrosion control in water treatment and distribution, (4) Cathodic protection, (5) Corrosion problems in power generation, and (6) Sewage and industrial wastes treatment. Twelve lectures delivered at these sessions by scientists and men from industry have been reproduced. Discussions that followed have also been included.

In his keynote address Prof. S. J. Arceivala, then Director, CPHERI, discussed the various factors which affect corrosion with special reference to water and waste water engineering. He pointed out that the severity of corrosion depends on factors which could be summed up as follows: (i) relative position of metals in galvanic series, (ii) size of anode area with respect to cathode area, (iii) location of anode with respect to cathode, (iv) resistance of circuit, (v) type of composition of electrolyte, (vi) conductivity or resistivity of electrolyte, (vii) uniformity of electrolyte, and (viii) depolarizing conditions. A knowledge of these factors would enable the engineer to avoid those conditions which accelerate corrosion.

The proceedings of the technical course would be useful to civil engineers, public health engineers, water treatment chemists, power house maintenance staff and others who are concerned with design, operation and maintenance of water and waste water treatment and handling plants.

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CFRI PILOT PLANTS INAUGURATED

At a function held on 9 November 1972 at the Central Fuel Research Institute (CFRI), Dhanbad to mark the silver jubilee celebrations of the institute, Shri C. Subramaniam, Union Minister of Industrial Development, and Science and Technology, and Vice-President, CSIR, inaugurated three pilot plants and released three major research publications of the institute. The pilot plants inaugurated were: (i) continuous formed coke plant, (ii) pellet coke process plant, and (iii) pneumatic separator for selective preparation of coal for coking.

In his inaugural address the Minister stated that planning essentially involves harnessing of natural resources and knowledge into production and distribution of goods. Our research laboratories are concerned with acquisition, development as well as application of knowledge, both of raw material resources and of the production technology. Shri Subramaniam said that CFRI is the custodian of knowledge of one of the most vital sectors of our natural resources, namely coal. He pointed out that if it was possible for planning the continued growth of iron and steel industry in India without the import of foreign coal, it was only due to the researches at the institute. Commending the institute for its valuable contribution in the field of coal blending, he referred to the new CFRI's development of making 'synthetic coke' for metallurgical industries from non-coking coals, which is accepted for adoption in the first demonstration pig iron plant coming up in Orissa. This will be the forerunner for iron and steel plants to be set up all over the country on the basis of the new technology. Such a project will also serve the ferro-alloy industries of the country. The Minister stressed the role of the pilot plant being set up from the point of view of not only gathering design data but also for testing of coals from various sources and for assessment of the utility of the products for use in industries other than in the blast furnace. He congratulated the private firm for venturing to set up a commercial plant in Uttar Pradesh based on the CFRI process.

Shri Subramaniam appreciated the researches leading to the development of the technique for the utilization of the byproducts of coking coal washeries for the manufacture of domestic fuel and welcomed the negotiations on hand for the setting up of commercial plants. For meeting the large energy demand of domestic sector in the Fifth Plan, the Government proposes to set up at least two major plants for the production of smokeless fuel. For this purpose, consultation with State authorities and others are in progress. While these will be large scale plants, the institute's development of the pellet coke process, which he inaugurated, is economically viable even in smaller capacities of the order of 100 tonnes per day with a capital of about Rs 30 lakh. The plant can be fabricated from entirely indigenous resources, and is of particular interest to small and medium scale entrepreneurs. He exhorted the private industry to set up such plants to cater to not only the domestic needs of the populations but to the requirements of ferro industries. The publications released by the Minister were: (i) Studies on Coal Preparation in India, (ii) Studies on Coal Carbonization in India, and (iii) Monograph on Dishergarh Seam.

Continuous Formed Coke Plant

The process developed by CFRI for making metallurgical coke from non-coking coals [Indian Pat. 99654 & 99655 (1966)] is essentially as follows:

Non-coking coal (raw or washed) is ground to required size consist, chiefly below 3 mm and dried, if necessary, over a hot bed. The dried coal is transferred to a 'dilute phase fluid bed' pyrolysis unit, where the 'chemo-plast' constituents are quickly removed under conditions of temperature and operation at which maximum yields of condensable liquids (similar to tar) of requisite quality are obtained. The process aims at the removal of hydro-aromatic material from coal and phenols in their original form as far as possible, and suppresses side reactions during their condensation. Pyrolysis is generally carried out between 450 and 500°C depending on the nature of the coal. The hot char is pyrolyzed in a second 'dense phase' system over a hot roaster in which the char is calcined and the gas is recovered. The hot char is cooled and stored.

The condensed liquids (pyrolyzed chemicals) are treated to produce the material suitable for polycondensation reaction, and stored. The char and the polymerized binder are mixed in requisite proportions, generally 10:1, and briquetted into desirable size and shape in conventional briquetting plants. Depending on the nature of coal and the ore and other raw materials used for iron-making, fluxes, manganese ore, etc. can also be mixed and briquetted along with the char and the binder. The 'green' briquettes after being cooled are taken to a reaction furnace where the polycondensation reaction (curing) is induced and completed under controlled conditions of temperature and atmosphere, chiefly using a mixture of air and dried gases.

The cured briquette after being cooled is smokeless and strong enough for use in industrial and domestic hearths. However, for use in metallurgical furnaces, it may be desirable to further carbonize it; carbonization can be done in a vertical retort, also developed at CFRI.

Based on the successful operation for over 5 years of a plant of capacity 10 tonnes/day, a continuous 1 tonne/hr plant has been proposed, of which the briquetting and curing part, designed and erected by CFRI scientists and engineers, was commissioned on 9 Nov. 1972.

The applicability of the proposed formed coke in the blast furnace can be established only through further experimentation on a semi-commercial plant. It is with this objective that CFRI has sponsored the setting up of a formed coke plant (capacity, 350 tonnes/day) at Talcher, Orissa, for the production of pig iron and ferro-alloys. The Department of Mines & Metals (Ministry of Steel and Mines) in cooperation with the Industrial Development Corporation of Orissa Ltd appointed Chemical and Metallurgical Design Company to prepare a project report for an integrated plant for the production of low-phosphorus pig iron with the formed coke produced from the completely non-coking Talcher coals by the CFRI technique. The consultants chose the CFRI process after a detailed survey of other similar processes under development abroad. The total project is estimated to cost Rs 18.55 crore of which the formed-coke plant (including facilities for re-carbonization, if necessary) is estimated to cost Rs 2.84 crore. The production cost for this demonstration first-generation grass roots unit is likely to be of the order of Rs 190 per tonne, allowing for 12.5% return on total investment, which compares favourably with sale value of conventional metallurgical coke. The project will also enable production of custom-made 'coke' for a number of ferro-alloy industries (e.g. ferro-manganese, ferro-silicon, ferro-chrome and ferro-vanadium) as well as cokes for the carbide industry.

Pellet Coke Process for Production of Domestic, Industrial and Metallurgical Fuel

Presently, the domestic sector is the largest consumer of 'fuel' in India though the fuel is largely non-commercial, e.g. wood, charcoal, cowdung and agricultural wastes. The production of soft coke (by the wasteful *bhatta* process) hardly meets 5% of the demand. To meet the urban demands there has been a considerable increase in kerosene, which has to be imported. Bottled gas (LPG) can meet only a small fraction of the demand due to its limited availability.

The institute had endeavoured to develop a number of processes to meet the growing urban demand for smokeless fuels. The vertical retort low temperature carbonization unit developed at CFRI has operated successfully over 12 years, and the Ministry of Mines, Metals & Fuels has selected this process for commercial development in the eastern region. This process is suited for large urban population and it can produce both gas and smokeless fuel from a large variety of coals and is extremely flexible in operation. In addition, it will produce large quantities of tar for chemical and carbon black industry.

Another process developed at CFRI involves the carbonization of sized non-coking or coking coals on a moving grate which could be built in 20 to 200 tonnes/day capacity units. This process is being utilized by a commercial firm in Hyderabad. The process is ideal for low-grade lump coking coals (or non-coking coals which do not decrepitate on coking) and does not involve byproduct recovery. However, this process cannot be applied to small or powdered coal such as will be produced in large quantities from washeries as 'middlings' and 'sinks'.

For utilization of such low-grade waste fuels as middlings, CFRI has developed a pelletization process, which in conjunction with the moving bed devolatilizer can produce an excellent smokeless fuel for domestic or industrial use (Indian Pat. 127909). Such plants can be fabricated with 100 to 200 tonnes/day capacities. No binders or complicated processes are involved in the production of such fuel.

Attempts are also being made to produce a spherical formed coke by this technique which may be able to incorporate a large proportion of low volatile, coking coals in blends (now considered unsuitable for metallurgical use) and may thus have its application in the metallurgical fuel industry as well. A continuous one tonne/hr pilot plant has been designed and constructed, entirely from indigenous sources, at CFRI. Similar attempts are being made in USA and UK to develop formed coke pellets on an experimental scale. However, in India, its immediate application lies in the field of domestic fuel and as a substitute for nut coke for a variety of industries, including electro-metallurgical industry. Capital costs are considerably lower than those of coke ovens, and sub-grade coking coals can be used.

The process consists of powdering the raw material, mixing with a small percentage of inorganic binder (if necessary), pelletizing the mixed fines in a rotating pelletizer without application of any mechanical pressure in the presence of water, drying the pellet, and finally devolatilizing the dried pellets on a moving grate carbonizer. The devolatilized pellets are quenched with water.

The advantages of the process are as follows:

(1) The process is relatively cheap since no mechanical pressure need be applied and no high proportion of special binder is needed. Also, there is no need for any sophisticated equipment and the equipment required can be manufactured indigenously.

(2) The process can utilize washery byproducts and inferior grade caking or coking coals of both coarse and fine sizes. It can permit inclusion of non-coking coals, coke breeze, char and also other ingredients.

(3) The pellet cokes obtained in the process are porous, less dense, closely sized, spherical in shape and homogeneous in nature, and consequently give better combustion performance characteristics in domestic ovens and furnaces.

(4) The process uses a small quantity of a cheap binder. It can be applied for the production of ferro-coke pellets for normal metallurgical use and also in the manufacture of ferro-manganese, ferro-silicon, ferro-chrome, ferro-vanadium, and calcium carbide, incorporating ores and other desirable ingredients like silicon and fluxes in the mixture.

(5) Sulphur dioxide emission during combustion of pellet coke (produced from high-sulphur coal such as Assam coal) can be suppressed by incorporating lime/dolomite in the pellet coke.

Pneumatic Separator for Selective Preparation of Coal for Coking

Selective preparation of coal yields better coke and permits inclusion of increased proportion of substandard coking components in the blend. This technique, in principle, has been applied in France and commercially experimented in USSR and Poland. However, the equipment tried so far are expensive, sophisticated and not free from hazards. Hundreds of experiments on pilot plant scale at CFRI have demonstrated that the process improves coke quality, even from inferior quality coking coals, and is perhaps a must for utilization of the substandard coals for metallurgical coke-making. The chief drawback is in devising the equipment for conveniently separating the 'inert' portion of the coals from the reactive components. An equipment based on pneumatic separation of coal has been developed and patented by CFRI (Indian Pat. 113417) in which the inert portion is conveniently separated from the reactive portion. The novel features of the equipment are:

(1) It works on closed air circuit.

(2) It does not require any sophisticated component and can be completely fabricated indigneously at low cost.

(3) It has wide flexibility of operation, and separation into the desired number of ranges/components can be effected with a high degree of efficiency.

(4) It is simple to operate and the power consumption is low due to high capacity per unit area of the separating duct.

(5) It does not employ any moving part and, therefore, the wear and tear is low.

The pneumatic separator comprises a low head blower and a closed circuit duct in which separation takes place. The duct originates from the delivery end of the blower and terminates at the suction end. A feed hopper with a feeder is placed on the duct near the blower end and a number of receptacles in the form of hoppers are placed below the duct to receive the various products.

The underlying principle of separation is based on the inertia of particles. The blower delivers air through the horizontal duct at a particular velocity and the particles are allowed to fall from rest across the duct. Particles having greater inertia, i.e. heavier and bigger particles, are less affected by the horizontal air current, whereas finer and light particles, which have lower inertia, are most deflected from their vertical path. As a result, the coarser and heavier particles follow more or less vertical path and fall into the receptacle nearer the feed point. The progressively finer particles fall into the receptacles away from the feed depending on their size.

Batch studies on the selective preparation of coal have been done on a 2.5 tonnes/hr pneumatic separator unit. A 5 tonnes/hr (120 tonnes/day) continuous plant has been designed, fabricated and erected at the institute. The plant is integrated with the high temperature coke oven plant of the institute.

Studies on Coal Preparation in India

This monograph contains a consolidated account of the work done by CFRI in the field of coal preparation during the last two decades. Various aspects of coal preparation dealt with are: (i) resource survey, (ii) fundamental studies, (iii) development of new processes/equipment, (iv) research and development studies, (v) pilot and semi-pilot plant studies, (vi) planning of coal washeries, (vii) performance studies, (viii) standardization of washery equipment and washing circuit for the treatment of coking coals, (ix) economics of coal preparation in India, (x) technical and consultancy services, and (xi) impact of research on industry. The monograph also contains a comprehensive list of patents and publications of CFRI.

The monograph (crown 4to, 261 pages) is priced Rs 55 (£4/ $10) per copy, and is available from the institute.

Studies on Coal Carbonization in India

This monograph contains a consolidated account of the work done by the institute in the field of coal carbonization during the last two decades. A wide coverage of various aspects of coal carbonization is given broadly under the following heads: (i) High temperature carbonization of coal, (ii) Low to medium temperature carbonization of coal, (iii) Carbonization of coal on chain-grate stoker, and (iv) Coal carbonization in fluidized bed.

The monograph (crown 4to, 383 pages) is priced Rs 40 (£ 3/$7) per copy, and is available with the institute.

Monograph on Dishergarh Seam

The monograph deals with: (i) general geology, (ii) reserves, production and utilization, (iii) physical and chemical properties, (iv) petrological studies, (v) pilot plant carbonization tests, and (vi) washability characteristics of the coals of Dishergarh seam.

The Dishergarh horizon of Raniganj Measures extends throughout the length and breadth of Raniganj coalfield. Total reserves are estimated around 650 million tonnes, a large proportion of which is of good quality (19% inerts). At Chinakuri the seam is worked at a depth of 75 m, deepest in India.

The monograph (crown 4to, 132 pages) is expected to lead to further utilization of this seam and also to its conservation for coking purposes. Copies of the publication (price Rs 32) are available with the institute.

Prof. G. S. Ramaswamy

Prof. G. S. Ramaswamy, Director, Structural Engineering Research Centre (SERC), Roorkee, returned to India on 30 October 1972 on the completion of a 16-month assignment at Baghdad, Iraq, as a United Nations expert attached to the Building Research Centre, Baghdad.

Prof. Ramaswamy's principal achievement during his mission to Iraq was the planning and equipping of the Structural Engineering Division of the Building Research Centre which when completed will be one of the best of its kind in the Middle East. He also reorganized the Steiger Factory for Prestressed Concrete Products, owned by the Ministry of Industry, to produce a variety of economical prestressed concrete roofing units for factory buildings. Iraq is poised for rapid industrial development, and Prof. Ramaswamy's contribution was highly appreciated by the Government of Iraq.

During his assignment, Prof. Ramaswamy also organized and directed a regional course on Prestressed Concrete for the countries of West Asia at Baghdad under the auspices of the United Nations and the Government of Iraq. Design engineers from Kuwait, Iraq, Syria, Jordan and Egypt participated in the course. Shri Zacharia George and Shri V.S. Parameswaran, Scientists of SERC, acted as UN consultants and participated in the running of the course. The Government of Iraq presented two plaques to Prof. Ramaswamy in recognition of his distinguished services. Prof. Ramaswamy had acted as UN consultant at Baghdad on two earlier occasions.

PROGRESS REPORTS

CSMCRI Annual Report : 1971

The annual report of the Central Salt & Marine Chemicals Research Institute (CSMCRI), Bhavnagar for 1971, seventeenth in the series, records projectwise the progress of R & D work under the following disciplines: Salt and Marine Chemicals; Desalination; Marine Algology; and Sea-water Irriculture. Twenty-eight projects in all were investigated during the year.

Processes for the manufacture of iodized and calcium-fortified salt having uniform composition were developed. The samples of fortified salts were tested by the National Institute of Nutrition, Hyderabad, and found suitable for use.

A fertilizer product ($MgKPO_4.H_2O$) was prepared from mixed salt. A sink float method was worked out for the preparation of fertilizer grade potassium chloride from carnallite, and epsom salt from "sels' mixts". Commercial production of potassium schoenite from mixed salt was started by Tamil Nadu Marine Transport Co, Tuticorin, on a plant commissioned with the technical assistance of CSMCRI at Tuticorin.

The bromine plant (150 kg/day) set up at the experimental salt farm was run to improve the overall efficiency. The maximum overall efficiency was found to be 90% and the average overall efficiency in the range 80-85%. Experiments were carried out on the purification of crude bromine and the final product was found to meet the IS specification for technical grade bromine. The process was released to four parties.

In the field of desalination, studies on three major techniques, viz. distillation, ion-exchange and reverse osmosis, were continued. Solar stills of 1.5, 7 and 12 litres capacities were supplied to parties. A new design for solar still has been developed to overcome difficulties encountered in the construction of concrete structure. Studies on the development of high performance surfaces were continued. Tests were carried out in a horizontal test rig on various tubes. Aluminium-brass tube showed the best performance. A technique for fabricating roped tubes was developed, and an aluminium tube, tested in the horizontal test rig, substantially increased heat transfer. A vertical test set-up was designed and is under fabrication.

Optimum conditions for the preparation of cellulose acetate tubular osmotic membranes to be used in reverse osmosis plant were worked out. A tubular reverse osmosis plant consisting of three modules each having sixteen tubular membranes (2.5 m long) was assembled and operated continuously for 60 days, and data on membrane performance, fouling, membrane life, and corrosion were collected. A tubular membrane was also prepared from the casting solution containing two grades of cellulose acetate, viz. E-400-25 and CA from Mysore, in the proportion 1: 1 by weight and tested for performance; the membrane was found useful. A tubular reverse osmosis plant was designed and fabricated for the Border Security Force.

Applications of reverse osmosis process were successfully worked out in regard to: (i) boiler feed water, (ii) concentration of cheese whey, (iii) concentration of dye waste from textile mills, (iv) concentration of papain and pectin extract, and (v) separation of salt from iron-dextran.

Cellulose acetate required for osmotic membranes was prepared from indigenous sources. The product is comparable to imported material in performance.

Desalination by ion-exchange and electrodialysis being economical is easily adaptable for treatment of brackish waters which are abundant in the arid and semi-arid regions of the country. An electrodialysis stack consisting of 50 cell pairs was built and operated in parallel-cum-series flow to treat water of different salinities. The unit desalined well water having 4500 ppm TDS (total dissolved solids) to 1700-1100 ppm TDS and the power consumption was 3.4 kWh per 1000 litres of product water.

A continuous countercurrent ion-exchange apparatus suitable for water softening has been developed. Optimum conditions were worked out for obtaining maximum efficiency in the performance. A water-softenting plant of 2500 litres/hr capacity has been successfully developed and operated for a long period.

Ion-exchange and membrane techniques have been successfully applied for the preparation of potassium nitrate, and boric acid (extra pure and free of chloride and sulphate impurities), and for the separation of sodium dichromate from waste water.

A survey of the standing crop of seaweeds was undertaken in collaboration with the Central Marine Fisheries Research Institute, Mandapam Camp and the Tamil Nadu Fisheries Department. The area covered during the year includes the shoreline in Palk Bay from Rameswaram to Attangarai, Gulf of Mannar from Mandapam to Kilkkari and the island in the Gulf of Mannar. Seaweeds extend to a depth of 4m, and a majority of them are submerged. Algin plants are more abundant than agarophytes.

A large scale cultivation of *Gracilaria edulis* has been started to work out the economics of cultivation. One thousand meters of rope were planted. The first harvest in November 1971 gave a yield of 643 kg of *Gracilaria*.

Studies on the protein and peptide hydrolysates as well as free amino acid composition of red alga species were continued. About 60 species were studied during the year. The data show that marine algae of Bombay region are richer in protein content (as high as 35 %) than those from southern coast and Mandapam region. *Sargassum* (brown) and *Gracilaria* (red) are found to be the best sources of protein.

A method for the preparation of agarose with low sulphate content, from agar-agar obtained from Indian seaweeds, has been developed on a laboratory scale.

Studies on assessment of sea-water tolerance during germination and seedling growth were continued with crops like safflower and *jowar*. Wheat (Karchia) was sown in a total area of 480 m². The growth and yield of crop was good in fertilizer dose of nitrogen, 90; P_2O_5, 60; and K_2O, 40 kg per hectare.

Five patents filed during the year relate to: (1) manufacture of bromine from bittern; (ii) improvements in or relating to interpolymer compositions and ion-exchange membranes; (iii) improvement in or relating to continuous countercurrent ion-exchange apparatus; (iv) improvement relating to procedure for conducting chemical conversions; and (v) a process for manufacturing double sulphate of potassium and magnesium (potassium schoenite) from mixed salt obtained from sea bittern. Twenty-one research papers were published.

The self-driven mechanical salt harvester designed and fabricated by CSMCRI received an award from the Inventions Promotion Board.

PROCESSES & PRODUCTS READY FOR COMMERCIAL UTILIZATION

Pig/Hog Bristles

Bristles are an important item of export. According to Export Regulation, the bristles meant for export should be properly cleaned and dressed. However, cleaning or scouring is not sufficient to completely eliminate discoloration, especially when substantial quantities of bristles are required to be processed. Bleaching of such bristles to white or off-white shade or dyeing them to fresh jet black shade makes them more attractive. Large quantities of bristles are obtained in curved state, and have to be straightened in order that they fetch a good price.

The Central Leather Research Institute, Madras, has developed a process for scouring, bleaching, dyeing, softening and straightening of bristles. Laboratory work on all the above stages of processing of bristles has been completed.

The plant and machinery required for the process will be the same as in the case of bristles washing units presently operating.

All the raw materials and auxiliary chemicals are easily available in India.

The additional cost of treating the bristles by the process developed is estimated at about 10 paise/kg.

Further particulars may be obtained from: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 110024.

Mud Thinner for Deep Drilling

A mud thinner suitable for use in deep drilling has been developed by the Central Leather Research Institute (CLRI), Madras, using an abundantly available tanning material. The mud thinner is stable at high temperatures and could be used as a substitute for imported products like LS-33, CL-20, Spercene and XP-20. The new product may perform better than cutch extract which at present is partly meeting the demand for mud thinners estimated at 1200-1500 tonnes/year. The rest of the demand is being met by imports of product like LS-33. The product prepared at CLRI was comprehensively tested in the laboratory, and also in the laboratories of the Oil & Natural Gas Commission, Dehra Dun and Oil India Ltd, Duliajan, Assam, and was found to be satisfactory. The laboratory prepared 2 tonnes of the product in its pilot plant for field trials. Tested in one of Oil India's wells in Nahorkatiya, Assam, the performance of the product is satisfactory. Further field trials in an outstep well and an exploratory well are also contemplated.

The raw materials for the production of mud thinner are indigenously available. Being a metallic derivative of myrobalan extract, the product could be prepared easily in any of the tannin extract manufacturing units without any additional equipment.

The cost of production has been estimated by the institute to be Rs 2000 to 2400 per tonne depending upon the cost of raw materials. The cost of imported mud thinner varies from Rs 4500 to 6000 per tonne.

Further particulars may be obtained from : The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 110024.

Oil Well Cement Additives

After a hole is drilled for tapping oil, it has to be completed by setting and cementing a pipe inside. During cementation, it is important that the cement should displace the mud in the annulus outside the pipe or casing as completely as possible, and should form bonding with the formation and the casing. Or else, channels of mud are left behind, leading to defective isolation. If there is any communication in the annulus permitting fluids from other levels, optimum control cannot be maintained and optimum recovery will not be obtained. The most effective way of ensuring a good cement in the annulus is to ensure turbulence in cement slurry at the time of its placement. In order to achieve this, it is necessary that the slurry should retain its fluidity because if there is rapid loss of water from slurry, flash or premature setting of cement may take place leading to other hazards. A good cement slurry should have low viscosity, low filtrate loss, setting time to suit operation and good strength on setting. The Oil India Ltd, the major consumer of this type of additive, is using Halad-9, an imported material, to achieve this objective by suitably blending with normal portland cement. The firm's present consumption is of the order of 30 tonnes per annum.

The Regional Research Laboratory (RRL), Jorhat, undertook investigations for finding a substitute for Halad-9. A formulation based on three different ingredients has been prepared at the laboratory. The ingredients are: (1) naphthalene formaldehyde polymer, (2) cellulosic product, and (3) vinyl polymer.

The laboratory has developed processes for the synthesis of the first two ingredients; vinyl polymer will have to be imported. The formulation as tested in the laboratory has been found to be better than Halad-9.

Naphthalene formaldehyde polymer is synthesized by the sulphonation of naphthalene followed by condensation of the naphthalene sulphonic acid with formaldehyde at a suitable temperature.

The cellulosic product is prepared by reacting ethylene oxide with alkali cellulose in an inert solvent at a suitable temperature. The alkali cellulose for the purpose is obtained by reacting purified pulp with caustic soda under controlled conditoions.

The products so obtained are blended with vinyl polymer in definite proportions to produce the final oil well cement additive. Tested at the Oil India Ltd, Duliajan, the additive was found satisfactory in all respects.

Naphthalene, formaldehyde and sulphuric acid are the major raw materials required for the production of naphthalene formaldehyde polymer; and ethylene oxide, sodium hydroxide, methyl alcohol, acetone, isopropanol and high-alpha cellulose pulp are the main raw materials for the preparation of the cellulose product. All the raw materials are indigenously available. To start with, ingredient No. 2 may have to be imported until the production unit is commissioned. Vinyl polymer will, in any case, have to be imported as the raw materials required for its synthesis are not easily available. However, it is required in small quantities.

The main items of plant and equipment needed for the production of the first two ingredients are: tank, reactors, condensers, centrifuge, spray-drier, heating mantles, filtrating unit, washing unit, and drying and recovery units. All these can be fabricated by machinery manufacturers in the country.

The capital investments required for producing 15 tonnes/year of the naphthalene formaldehyde polymer and 6 tonnes/year of the cellulose product are estimated at Rs 2.10 lakh and Rs 0.74 lakh respectively. The total capital cost for producing 26 tonnes of oil well cement additive with a manufacturing programme for ingredients No. 1 and No. 2 has been estimated at Rs 2.84 lakh. The cost of production of the ingredient No. 1 comes to Rs 9.00/kg, while the cost of production for ingredient No. 2 is Rs 21.00/kg. The cost of production of the final product including the third ingredient (to be imported) comes to Rs 20.50/kg.

Further particulars may be obtained from: The Managing Director, National Research Development Corporation of India, 61 Ring Road, Lajpat Nagar III, New Delhi 110024.

Aluminium Conductor for Telecommunication Cable

An aluminium alloy conductor has been developed at the National Metallurgical Laboratory (NML), Jamshedpur, for use in telecommunication cable manufacture. Conventional telecommunication cables are made of copper which due to shortage of production have to be imported.

Production of telecommunication cable at Hindustan Cables Ltd, Rupnarainpur, from NML-developed aluminium alloy conductor

The electrical and mechanical properties of the aluminium alloy conductor have been evaluated according to IS: 1753-1967. The material has been produced on tonnage scale. A 20-pair dry core communication cable has been successfully manufactured at Hindustan Cables, Rupnarainpur, satisfying the requirements of the Posts & Telegraphs Department. The cable is undergoing extensive field trials and tests in collaboration with the Telecommunication Research Centre, New Delhi.

CSIR SUPPORT TO RESEARCH

Completed Schemes

Hydromagnetic Oscillations of Gaseous and Fluid Spheroids

The oscillations of a self-gravitating uniform-density fluid spheroid in hydrostatic equilibrium with a poloidal magnetic field inside and a dipole field outside the boundary have been examined, using a variational principle and tensor virial equations, by Shri N. K. Sood, a CSIR research fellow, who worked under the supervision of Prof. S. K. Trehan at the Department of Mathematics, Panjab University, Chandigarh.

Studies on the Kelvin mode of oscillation (of this equilibrium model) obtained by using a variational principle show that the magnetic field increases the oscillation frequency of this mode in agreement with known results [Woltjer, L., *Astrophys. J.*, **135** (1962), 235]. Analysis of stability conditions of the compressible as well as the incompressible modes of oscillations of the same equilibrium model, using the second-order tensor virial equations shows that when the ratio of magnetic energy to gravitational energy is small, the equilibrium model is dynamically stable provided the usual criterion of dynamic stability ($\gamma \geqslant 4/3$) in the absence of a magnetic field is satisfied. This result is also in general agreement with that of Wentzel [*Astrophys. J.*, **135** (1962), 593].

Extending the studies to a density distribution in which pressure p and density ρ are related by a power law: $p = K \rho^{1+1/n}$, n being the polytropic index, the equilibrium structure of a polytrope with a prevalent toroidal magnetic field was reviewed following the broad outlines of the method used by Chandrasekhar and Lebovitz [*Astrophys. J.*, **136** (1962), 1082] for rotating polytropes. The oscillations of this model have been examined in detail using a variational principle. This included a study of the radial modes and the non-radial modes corresponding to deformations belonging to spherical harmonics of orders $l=1$, 2 and 3 and for polytropic indices $n=1$, 1.5, 2, 3 and 3.5. The calculations have been carried out in the first as well as in the second approximations.

Rotating Gaseous Masses

Studies on the oscillations and the stability of rotating gaseous masses have been made by Shri R. K. Kochhar, a CSIR research fellow, at the Departments of Mathematics and Observatory, Panjab University, Chandigarh, during the period 1968-71 under the guidance of Prof. S. K. Trehan of the Department.

The formalism of the problem has been developed to a stage where it can be readily applied to specific problems. Analysis of the case when the kinetic and magnetic energies are equal (equipartition state) has brought out the errors in the results of Kristian. Another problem that has been investigated is the general situation where there are toroidal velocity and magnetic fields in a configuration which is rotating with constant angular velocity. The various modes of oscillations have been discussed and their stabilities examined. In particular, the effect of a toroidal magnetic field on the secular and dynamical instability of the system of rotating masses has been investigated.

It has been shown that the point of bifurcation where the Jacobi series branches off from the Maclaurin series ($e=0.81267$) remains unaffected by the presence of either a toroidal magnetic field or differential rotation. The point of onset of dynamical instability does depend upon the magnetic field and is, in fact, advanced to values higher than the one that obtains in the absence of magnetic fields ($e=0.95289$).

Integrated Circuit Components

A detailed study of the integrated circuit components, especially resistors and capacitors which exhibit nonlinear properties, has been made by Shri M. L. Gupta, a CSIR research fellow, who worked at the Physics Department, Indian Institute of Technology, Delhi, under the guidance of Dr A. B. Bhattacharyya of the department. Switching circuits employing transistors and transistor-tunnel diode combinations were also studied. The theoretical results were verified experimentally wherever it was possible.

Diffused impurity layers: The evaluation of the average conductivity of diffused impurity layers with different profiles is of considerable practical importance. The average conductivity depends on the type of diffusion used, the junction depth, the mobility, the background concentration and the surface concentration. Mobility being a complicated function of temperature and impurity concentration, it makes the calculation of average conductivity difficult. Numerical methods using a digital computer do not permit ready calculations for various diffused structures at different temperatures. An analytical method has been suggested for the evaluation of diffused impurity layers in silicon and germanium with complementary error function and Gaussian impurity profiles and the results were found to be in good agreement with those obtained by numerical integration method.

Temperature coefficient of monolithic resistors: In semiconductor integrated circuits, diffused resistors are formed simultaneously with transistors, diodes and diffused capacitors. The resistance mechanism in semiconductors, however, is entirely different from that in conductors. In semiconductors, the number of available charge carriers is relatively small and is dependent on the temperature. Diffused resistors, therefore, have a strong and not easily described temperature coefficient. An analytical method has been suggested for the calculation of the temperature coefficient of a diffused resistor, and theoretical results were found to be in good agreement with experimental results in the useful and normal operating temperature range.

Effect of lateral diffusion on planar resistors: As technology advances and the dimensions of the diffused resistors grow smaller, the lateral diffusion effect assumes significance. The effect of lateral diffusion on the value of the diffused resistor was investigated for different surface and background concentrations. It has been shown that through a suitable correction factor for the resistor width, obtained analytically, a more realistic resistor design could be achieved.

New model for diffused resistor: A new model for the diffused resistor has been developed; it is quite simple, yet sufficiently accurate to provide a sound basis for the design of integrated circuits. The model is used for the study of a notch filter and a phase shift oscillator.

Voltage variable junction diode capacitors: In recent years *p-n* junction has been used as a monolithic capacitor and in various electronic devices. The nonlinearity of the *p-n* junction capacitance brings about an additional flexibility in pulse shaping circuits. Transient response of *p-n* junction capacitance to step and ramp inputs were studied and were found to be significantly bias dependent. Only graded and step junctions were considered as they typically characterize most of the semiconductor diodes. The study revealed that unlike the linear capacitor, the diode transients exhibit a steepest slope or extremum at some point (inflection point) other than zero on their respective curves. The experimental observations confirmed the general theoretical conclusions.

Switching transients of transistors: The transistor has been used as a switch in digital computers and other digital systems. In most practical circuits, the transistor is driven by a constant voltage drive applied through an R-C speed-up network in the base lead of the transistor. In integrated circuits, however, a voltage dependent *p-n* junction diode will act as speed-up capacitor. The transistor switching times with nonlinear speed-up capacitor were obtained using charge control concept. The experimental results were found to be in good agreement with the theoretical results.

Tunnel diode-transistor hybrid circuits: A tunnel diode has the advantages that it switches very rapidly, responds to a pulse of very small energy and may be used in bistable state. The transistor has on the other hand the advantages of operating at appreciably higher voltages and provides isolation between input and output. The combinations of tunnel diode and transistor in circuits exploit the merits of each device. Different possible combinations using tunnel diode and transistors were studied. Interesting results were obtained when a tunnel diode was put between collector and emitter of a transistor. The circuit could be made to work as a binary. The circuit is not only simple and more reliable than a tunnel diode binary but may go to higher frequencies than the transistor binary.

New Schemes

Biochemical Studies on Aging in Reptiles

The object of a new CSIR research scheme granted to Dr B. K. Patnaik (principal investigator) of the Berhampur University, Berhampur is to carry out studies on reptilian aging to evaluate the trend of change. The results of the proposed scheme are likely to throw light on: (i) whether reptiles undergo aging, and (ii) how the trend of age-related changes in the poikilothermic animals differs from that of homeotherms.

Measurement of the Rate of Primary Production in the Varanasi Grassland

With the increasing demand of rapidly rising human population on the natural resources an immediate and fresh appraisal of organic productivity of vegetation around us has become essential. It is against this background that the International Biological Programme has been launched. Accounts of production studies and measurement of productivity techniques of Indian grasslands have been given by some workers. The rates of net primary production in certain dominant grass species have also been estimated.

Some ecological aspects which need investigation include comparison of primary productivity values obtained through different methods, and correlation between phytosociological values such as species content, diversity, and dominance, with production rate.

Under a new CSIR research scheme granted to Dr R. S. Ambasht (principal investigator) of the Department of Botany, Banaras Hindu University, Varanasi, it is proposed to measure the rate of primary production, both by individual dominant species and plant communities in the grasslands of Chakia hills and local alluvial plains, specially in relation to biotic factors.

Primary Productivity of Deciduous Forests of Semi-arid Regions near Udaipur

The most important ultimate objective of ecology is an understanding of community structure and function from the viewpoint of its metabolism and energy relationship. Being an attribute of community function, productivity has attracted much attention in recent years. The extent of information available in the productivities of different woodlands of temperate and West Pacific region has been reviewed by some workers. Very little is known about the monsoon tropical deciduous forests. In India, studies on the productivity of forest communities of semi-arid parts of Rajasthan have been initiated by Dr L. N. Vyas and coworkers of the Department of Botany, School of Basic Sciences & Humanities, University of Udaipur, Udaipur.

Study of the quantitative aspect of litter fall is an important path of forest ecology dealing with a major pathway for both energy and nutrient transfer. In India, estimation of annual litter production in deciduous and some evergreen forests has been made by some workers. Such information on the deciduous forests of Rajasthan is completely lacking. The object of a new CSIR research scheme granted to Dr Vyas (principal investigator) is to find out net primary productivity of important species of the semi-arid zone of Rajasthan and its bearing on afforestation and human civilization.

PATENTS ACCEPTED

Indian Pat. 129039

Improvements in or relating to a domestic *angeethi* or *sigree* for the combustion of char fines and/or like materials of sizes ranging from 6 to 20 mm

A.N.E. Rahman, D.P. Agrawal &
R. Vaidyeswaran
RRL, Hyderabad

A vast majority of Indian kitchens still employ *angeethi* or *sigree* (stove) using solid fuels like soft coke, kolsit, leco and charcoal for cooking. The size of the fuel normally used is above 12 mm owing mainly to the limitations of fuel grate openings in ordinary appliances. Fines below 12 mm cannot be used even if the spacing between the bars of the grate is reduced to retain fines, as it results in compaction of fuel bed and insufficient air supply. The fines below 12 mm, which are cheaply and abundantly available, have thus very limited use.

The invention covered by the patent relates to the modification in the domestic *angeethi*/*sigree*, especially the fuel grate of the *sigree*, for obtaining maximum useful heat from the char fines and/or similar materials of 6-12 mm or 10-20 mm size. The modified *sigree* is characterized by its fuel grate system of concentric chimney type. It contains a bottom plain grate with a central hole on which a central chimney portion is fitted. A peripheral chimney portion is also fitted along the periphery of the plain grate.

The basic principle underlying the modification is to provide optimum air supply per unit of particle surface area. This has been made possible by using concentric chimney system of grate in which alternate space works are meant for holding the fuel or air inlet. This design ensures easy ignition and practically complete combustion of the fuel fines. The grate can be cast in one or more parts from cast iron or mild steel rods and can be incorporated in the usual cast iron or mild steel *sigree* or even in a *sigree* made of mud. It is thus possible to utilize charcoal fines, char fines, leco fines or similar materials for domestic heating purposes. The material ignites easily (in about 10 min) and burns smoothly and completely (unburnt material left at the end is less than 5%), giving a satisfactory rate of evolution of heat in about 10 min after ignition.

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